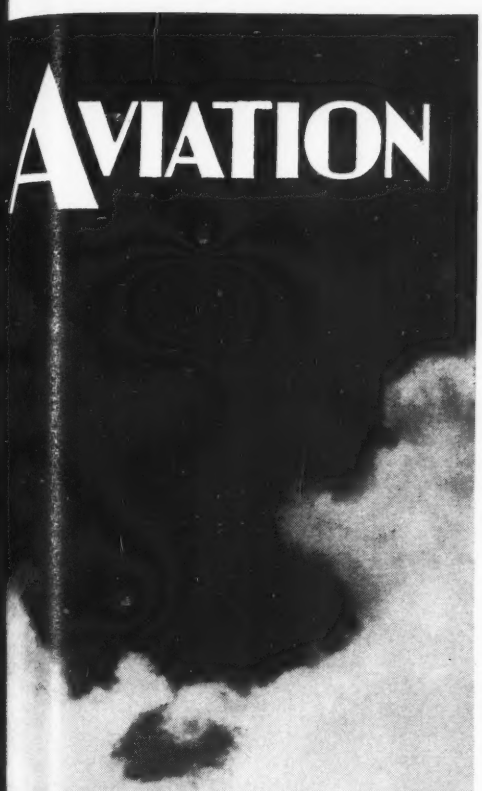

TENTH ANNUAL DIRECTORY NUMBER

February, 1943

Volume 42 • Regular Edition • Number 2

TOLEDO PUBLIC LIBRARY MAR 4 1943
TECHNOLOGY DEPARTMENT

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McGRAW-HILL PUBLISHING CO., INC. Publication office 99-129 North Broadway, Albany, N. Y. **Editorial and executive offices, 330 West 42nd Street, New York, N. Y.** Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; Los Angeles; Boston; Atlanta. JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; HOWARD EHRLICH, Executive Vice-President; MASON BRITTIN, Vice-President; B. R. PUTNAM, Treasurer; JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation. Aviation, 330 W. 42nd Street, New York. Issued monthly, price 50c a copy, 50c in Canada. Allow at least ten days for change of address. All communications about subscriptions should be addressed to Director of Circulation, 330 West 42nd Street, New York. Subscription rates—United States, Mexico and Central American Countries, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada, $3.50 for one year, $5.00 for two years, $6.00 for three years, payable in Canadian currency at par. Great Britain and British Possessions 30 shillings per year, 60 shillings for two years. All other countries $5.00 a year, $10.00 for three years. Entered as second-class matter, September 3, 1936, at the Post Office, Albany, New York, under the Act of March 3, 1879. Volume 42, Number 2. Printed in U. S. A. Cable address; "McGrawhill New York." Member of A.B.C. Copyright 1943 by McGraw-Hill Publishing Company, 330 West 42nd Street, New York, N. Y. The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owner. The following publications are combined with AVIATION: AERONAUTICAL ENGINEERING AIRCRAFT JOURNAL, and THE AVIATION NEWS. All rights to above names are reserved by McGraw-Hill Publishing Co. Aviation is indexed in Guide to Periodical Literature and in Industrial Arts index.

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Mining—Number One War Industry

The mineral products of the earth are the prime necessities of war... and peace

THE SURFACE of the earth provided primitive man with the things he needed for his meager existence but civilization really began when he became curious about its interior. This curiosity has brought us a long way. For the earth has yielded — out of its deep recesses — all the raw materials of modern industry. And today, in the grueling race of production, our mining industry is providing the raw materials upon which depends our survival. Our mines and quarries must supply a long list of materials without which a successful war cannot be fought.

Take steel, for example. War without steel is inconceivable. Steel starts with iron ore, limestone and coke. These are products of mines and quarries. It takes power and heat to get these materials out of the ground, to refine them and to transport them to the point where processing begins. All the subsequent operations culminating in the steel ingot, shape or plate, and in moving the final product to the point of use require power and heat.

The major source of this power and heat is coal.

Production of a ton of steel, it has been stated, requires two tons of coal. Smelting of the pig iron alone, 60,000,000 tons in 1942, required the coking of some 75,000,000 tons of coal. Pig output is expected to rise to 68,000,000-70,000,000 tons in 1943, carrying coal consumption up to 85,000,000 tons. At the same time, output of steel ingots is expected to rise from 87,000,000 to 97,000,000 tons. Think what this means in terms of power and heat.

Another vital metal is copper. Modern armies need copper. This point is dramatically illustrated in a recent memorandum by Robert P. Patterson, Under Secretary of War, in announcing the release of 4,000 men from military service to return to the mines and increase copper production. "In a single minute of combat", Mr. Patterson declared, "a flight of 50 fighter planes shoots away 7 tons of copper. A 37-mm. anti-aircraft gun uses up a ton of copper every twenty minutes it is in operation. Six hundred pounds of copper go into every medium tank, and a ton into the engines and airframe of a Flying Fortress. The Signal Corps alone needs 5,000 tons of copper every month for radio and telegraphic and telephonic equipment. An army without copper would be an army without speed, maneuverability or firepower. It would not last a day in battle".

Seven tons of copper for one minute of combat by 50 fighter planes means from 200 to 700 tons of ore, depending upon its grade. Small wonder that the War Department was willing to release drafted miners from military duties to produce more copper.

But other metals are equally important in war: tungsten, nickel, manganese, chromium, vanadium and molybdenum for alloy steels; zinc for brass and die castings; tin for bronze and bearings; aluminum and magnesium for aircraft; lead and mercury for ammunition; silver for electrical equipment, bearings and solder, and so on. Even relatively insignificant non-metallics, like mica and diamonds, suddenly assume critical importance.

And let us not lose sight of the fact that without adequate energy, i.e., heat and power, production, processing, transportation and the relative comforts to which we have become accustomed would be impossible under war conditions. Coal is the major source of energy in the United States. It supplies more than half the total in normal years.

The railroads of the country alone used 110,000,000 tons in 1942 to move freight and passengers and service their facilities. Utilities consumed over 68,000,000 tons in the production of electric power. Over 135,000,000 tons of coal were consumed last year in maintaining the level of heating comfort necessary for the maintenance of efficiency and morale. The consumption, this year, will be even greater.

In short, the mineral products of the earth are the prime necessities of war.

The nations that control the world's mineral resources and make the most efficient use of them will win the victory.

Before the war, the British Empire and the United States together controlled probably 75 per cent of the world's mineral production. This would have been a most potent weapon in the United Nations' arsenal if the whole strategy of Axis expansion had not been influenced by mineral objectives. Addressing the American Zinc Institute on the subject last April, E. W. Pehrson, of the U. S. Bureau of Mines, estimated that the Axis had improved its position in world mineral resources in the following percentages: iron ore, from 6 to 46; steel production capacity, 20 to 34; petroleum, 1 to 7; coal, 27 to 53; copper, 5 to 10; lead, 7 to 22; zinc, 16 to 27; tin, 1 to 72; manganese, 2 to 30; chrome, 3 to 30; tungsten, 6 to 60. In the light metals, areas now Axis-controlled produced in 1940 54 per cent of the world's aluminum, 49 per cent of the bauxite (the principal source of aluminum) and two-thirds of the magnesium.

This is the eighth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and in daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

Despite these gains, the industrial war power of the United Nations still can outweigh that of the Axis by a considerable margin. It already has begun to surpass it. The problem is to convert quickly our potential mineral resources into implements of war. In this conversion, a heavy burden of responsibility has been placed on the mining industry of the United States as the largest producer of many metals, minerals and fuels. In fact, the United States mining industry began to go on a war basis a year before Pearl Harbor. The curves of demand for domestic copper, lead, zinc and other metals began to rise sharply in 1940, and were paralleled by a rising coal production.

How well the job has been done cannot be revealed in accurate figures in many cases because of censorship. In metals, however, some idea of production gains can be indicated in comparative terms. United States copper production, for example, is breaking all previous records. Aluminum capacity will be more than seven times its annual peace-time average. Magnesium plants now building will have a capacity 100 times the largest yearly before-the-war figure. Molybdenum, of which the United States has the largest single mine in the world, is being made available in record quantity. Zinc, lead and mercury are surpassing expectations in meeting wartime demands, and tungsten, chromium, manganese, antimony and iron and steel are being turned out in record-breaking quantities.

Bituminous coal production in 1942 was 580,000,000 tons, the greatest in history, valued at more than $1,300,000,000 at the mine. Some 430,000 or more men were employed in 1942 and received at least $750,000,000 in wages. Bituminous production in 1939 was 394,855,000 tons, while the output for 1943 is forecast at approximately 600,000,000 tons — another new United States record. The 1942 anthracite output was 59,961,000 tons, valued at over $270,000,000 at the mine. The industry employed some 85,000 men and paid out at least $180,000,000 in wages. The 1939 production of anthracite was 51,487,000 tons, and the forecast for 1943 is 65,000,000 tons or more.

Marshalling the Western Hemisphere's mineral resources, the United Nations have been the beneficiaries of the diversified resources of two continents — in particular of Canada's nickel and coal, Mexico's lead and antimony, Chile's copper, Bolivia's tin, Peru's vanadium, Brazil's iron, and Venezuela's petroleum. With other United Nations contributing their share of metals and fuel, the grand total is an impressive array of potential munitions and matériel to lend assurance of certain victory over the Axis. Sheer weight of metal, properly used, will win the war, and our mineral industry will have played an indispensable and essential part in the inevitable outcome.

President, McGraw-Hill Publishing Company, Inc.

Wheels for Production

IN 1943 the aviation manufacturing industry is called upon to double 1942 plane production in units and increase total poundage fourfold. Although this will not be easy, it should be well within the realm of possibility for an industry which has been doubling and redoubling its output steadily for the last three years—in spite of handicaps on every side. Some of these deterrents have been the result of unforeseen war emergencies which should have been foreseen. Some may be traced back to old weaknesses in strategy and planning. And many of the subsequent attempts to find solutions have been negative rather than positive in their approach.

Probably the greatest single threat to the aviation production program for 1943 is the critical shortage of transportation and of housing with which we are now faced in defense areas. These two problems must be considered together because of their joint effect on the manpower situation, which will be one of the major headaches of 1943. We have built most of the factory facilities for the present program.

Tooling of this floor space is progressing rapidly and in most cases has been completed. The next important step is to make greater use of these facilities by increasing personnel to the fullest extent. In order to accomplish the production objectives set for this year, we will have to recruit almost as many more workers as we had in the industry at the end of 1942.

THE VAST NEW ARMY of workers that must be raised this year must also include replacements for military separations and for workers lost to other industries because of slack periods while waiting for materials and supplies. In order to do this it will be necessary to draw heavily on all available sources of over-age and handicapped workers, and a very substantial number of the new workers must, and will, be women.

There are many localities where the available personnel will be insufficient to meet the demand, hence we have to prepare ourselves to face the problems of migration of labor. When migratory labor includes women, the housing problem becomes much more acute because the erstwhile distaff side requires more elaborate living quarters. Already there are plants in which full production cannot be achieved because of housing shortages. When housing facilities are overtaxed, the problem becomes one of transportation between the plant and the nearest uncrowded community.

APPROXIMATELY 80 PERCENT of the aircraft workers are now using private automobiles for commutation to plants. Last year's drives to increase passenger car loadings have been so successful generally that there is not much passenger car capacity remaining to be tapped. Public transportation facilities have been dangerously overtaxed by the recent ban on non-essential driving in the East. These facilities elsewhere are seriously overloaded. And most aviation plants, particularly those dispersed in the wide-open spaces, are so located as to depend almost entirely on transportation by private automobile. Some means must be found to enable the new hundreds of thousands to reach their work.

Manufacturers who have not yet done so, should re-examine their housing and transportation requirements in the light of their expanded production assignments for 1943 and take whatever steps are within their power to increase housing and transportation capacity.

But the greatest responsibility lies with the several government agencies concerned with these problems. Unless emphasis is shifted from the negative policies of curtailment to the positive procedure of acceleration of all the programs necessary to the expansion of essential transportation and housing, our industrial machine will, this year, bear the brunt of our losses of tankers, merchant shipping, and rubber in early reverses in the Atlantic and Pacific.

Leslie E. Neville

AVIATION'S
WAR COMMUNIQUE
NO. 14

America at War

The Commander-in-Chief tells the world how America has given the United Nations full air superiority. New Aircraft Production Board set up to control and coordinate production. Latest reports on performance of our aircraft on the world's fighting fronts.

THIS FOURTEENTH COMMUNIQUE finds your Commander-in-Chief himself reporting the greatest aviation news in history.

In his annual message to Congress on the state of the Union, the President said that the United States, the British, and the Russians will hit the enemy heavily and relentlessly from the air. Day after day, he said, we shall heap tons upon tons of explosives on their war factories, utilities, and seaports.

Japanese strength in ships and planes is going down and down, he stated, and American strength in ships and planes is going up and up. That will become evident to the Japanese people themselves when we strike at their own home islands and bomb them constantly from the air.

In support of his words, the President revealed that even today we are flying as much lend-lease material into China as ever traversed the Burma Road, sometimes flying on instruments over 17,000-ft. mountains.

These Victory-auguring promises delivered by the head of this country, with its unmeasured war resources, stirred deep misgivings in the hearts of enemy rulers, lest their people begin to realize the true forces that are being brought against them. The Germans made a frantic attempt to jam all the United Nations radio stations which beamed the President's speech in every direction, in every language.

Mr. Roosevelt said that few Americans realize the amazing growth of our air strength, though he said he felt sure the enemy does. Day in and day out our air forces are bombing the enemy and meeting him in combat on many different fronts all over the world.

And for those who question the quality of American warplanes and the ability of our fliers, the President pointed to the fact that in Africa we are currently shooting down two enemy planes to every one we lose, and in the Pacific and Southwest we are knocking them down four to one.

He referred to the enormity of Hitler's and Mussolini's miscalculations in assuming they would always have the air superiority they enjoyed when they bombed Warsaw, Rotterdam, London and Coventry. That superiority is gone forever, he said.

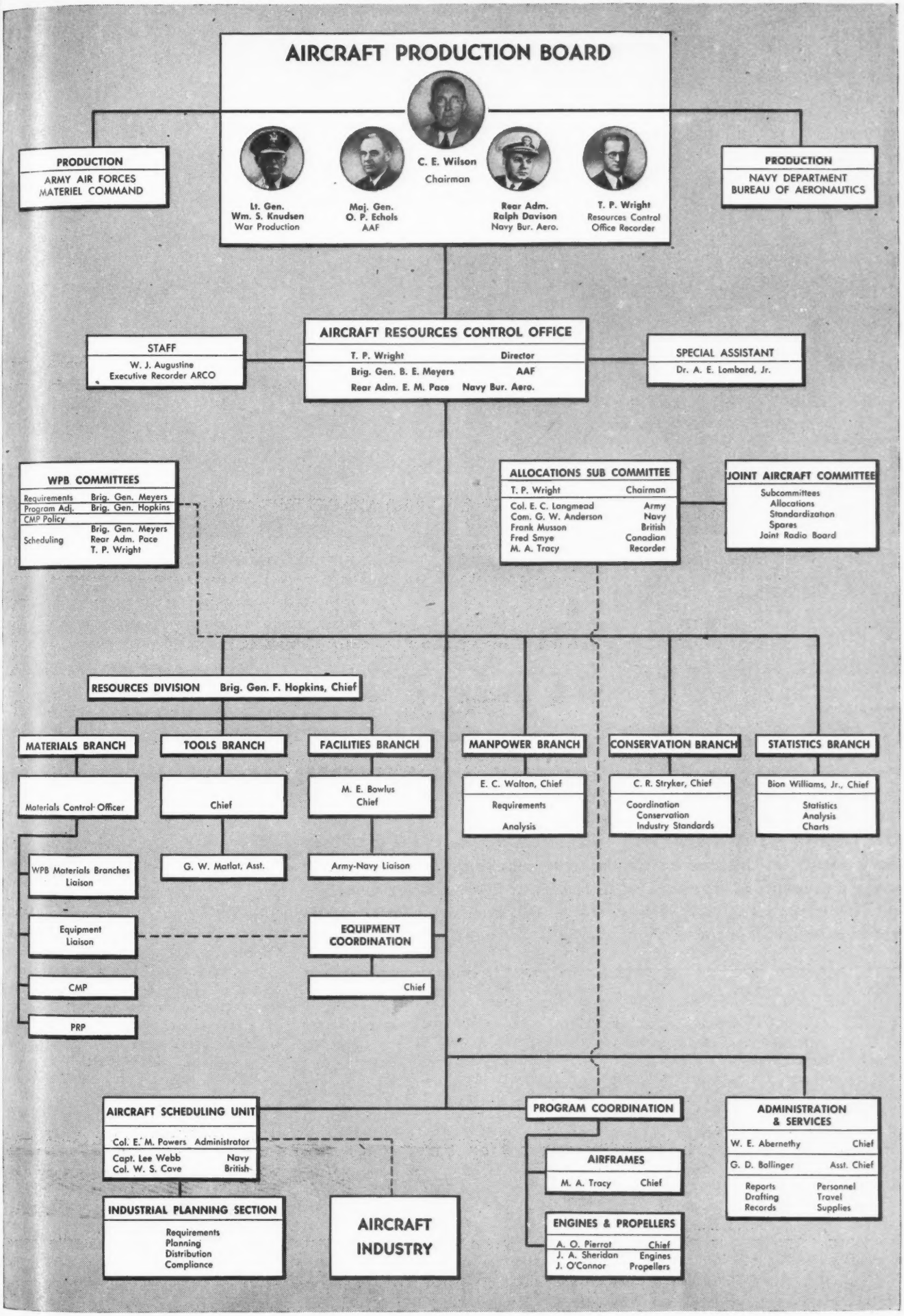
Our 1942 airplane and tank production fell short only a bit numerically, and Mr. Roosevelt emphasized that last word. We have every reason to acclaim our incredible production in 1942. We turned out just short of 50,000 military planes—more than the airplane production of Germany, Italy, and Japan put together. In December, we produced 5,500 military planes, he said, and the rate is rapidly rising. As each month passes, the averages of our types of planes weigh more, take more manhours to make, and have vastly more striking power.

Meanwhile, reorganization of the War Production Board's authority over aircraft production, begun several weeks ago, is nearly completed at this writing. As front line experience demonstrated that aviation ranks alongside of ships as a major weapon, the administration determined to clear all channels for airplane production. This determination resulted in the appointment of Charles E. Wilson to head a new "Little WPB" for airplanes, titled officially the Aircraft Production Board. Certain of the personnel still remained to be appointed, but the main framework of the organization is revealed in the chart accompanying this article.

Actually, Mr. Wilson did not wait for completion of his set-up before going to work. For weeks he has been smoothing the flow of materials to the airplane manufacturers, some of whom had been slowed as much as 25 percent because their supplies did not come in. It was mainly the materials delay, months

(*Turn to page* 400)

The Aircraft Production Board was set up recently by administrative order. The board, in turn, has established the Aircraft Resources Control Office to act as its executive agency on matters pertaining to materials, tools, manpower. ARCO also serves as coordinating agency for Materiel Command of Army Air Forces, Navy Bureau of Aeronautics, and WPB on schedules of aircraft, engines and propellers, and on matters involving materials conservation and statistics. The Air Force Materiel Command is under Maj. Gen. Oliver P. Echols, with headquarters at Wright Field, called the Materiel Center. Procurement of aircraft is under Procurement Division, commanded by Maj. Gen. K. B. Wolfe. Production Division has three sections: Production Engineering, Production Requirements, and Production Control. Chart shows how Services tie in with the board, with Gen. Meyers and Adm. Pace, of Army and Navy, in ARCO with T. P. Wright, its director; and (lower left) how Aircraft Scheduling Unit hooks directly to main stem from the board. Under this new setup, manufacturers will contact Scheduling Unit as heretofore. Information circulars will come from ARCO, instead of from old Aircraft Division of WPB.


AIRCRAFT PRODUCTION BOARD
C. E. Wilson
Chairman
Lt. Gen. Wm. S. Knudsen
War Production
Maj. Gen. O. P. Echols
AAF
Rear Adm. Ralph Davison
Navy Bur. Aero.
T. P. Wright
Resources Control
Office Recorder
PRODUCTION
ARMY AIR FORCES
MATERIEL COMMAND
PRODUCTION
NAVY DEPARTMENT
BUREAU OF AERONAUTICS
STAFF
W. J. Augustine
Executive Recorder ARCO
AIRCRAFT RESOURCES CONTROL OFFICE
T. P. Wright Director
Brig. Gen. B. E. Meyers AAF
Rear Adm. E. M. Pace Navy Bur. Aero.
SPECIAL ASSISTANT
Dr. A. E. Lombard, Jr.
WPB COMMITTEES
Requirements Brig. Gen. Meyers
Program Adj. Brig. Gen. Hopkins
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Subcommittees
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Standardization
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Joint Radio Board
RESOURCES DIVISION Brig. Gen. F. Hopkins, Chief
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Materials Control Officer
WPB Materials Branches Liaison
Equipment Liaison
CMP
PRP
TOOLS BRANCH
Chief
G. W. Matlat, Asst.
FACILITIES BRANCH
M. E. Bowlus
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Army-Navy Liaison
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Bion Williams, Jr., Chief
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Analysis
Charts
AIRCRAFT SCHEDULING UNIT
Col. E. M. Powers Administrator
Capt. Lee Webb Navy
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INDUSTRIAL PLANNING SECTION
Requirements
Planning
Distribution
Compliance
AIRCRAFT INDUSTRY
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Personnel
Travel
Supplies

U. S. Signal Corps Photo

Lt. Gen. Henry H. Arnold

USAAC Photo

Lt. Gen. Delos C. Emmons

The American Doctrine Of Air Power

Part I

By **NATHANIEL F. SILSBEE**
Major, Air Corps

Our country has developed its own theories of war in the air. They have stood the test of battle, have revolutionized even the most modern concepts of waging war. This series of two articles describes this doctrine, tells when and where it was conceived, and credits the men responsible for it.

WHEN Capt. Eddie Rickenbacker returned from an official inspection trip to England made at the request of Gen. Arnold he reported to the Secretary of War that "American conceptions of Army aircraft and their tactical employment are proving sound in combat and that the British look upon the practical application of our air war theories with increasing approval."

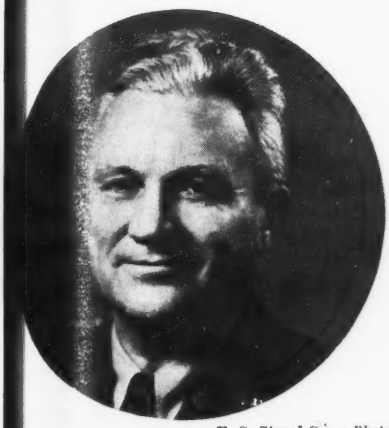
What are these American "air war theories?" When and where were they conceived? Who are some of the men responsible for their development?

Although the aviation contribution of this country in World War I was more considerable than is commonly supposed, it is safe to say that the real beginning of American air power, as far as the Army is concerned, may be dated from March 1, 1935. On that date the GHQ Air Force was established, embracing all tactical Air Corps units within the United States. The Army Chief of Staff, Gen. Douglas MacArthur, secured a temporary brigadier generalcy for Col. Frank M. Andrews, of the Air Corps, and directed that he select a staff, proceed to Langley Field, establish his headquarters for the General Headquarters Air Force, and see what he could do on a year's trial.

Gen. Andrews selected for his chief of staff Col. Hugh Knerr, stationed at Patterson Field, and who from 1926 to 1930 was commander of the 2nd Bombardment Group, Langley Field. He was succeeded in 1938 by Brig. Gen. George H. Brett.

Gen. Andrews' air command consisted of four Bombardment groups, three pursuit (now called Fighter) groups, and two attack (now Light Bombardment) groups organized into three Wings. The First Wing had its headquarters at March Field, and its initial commander was Brig. Gen. (now Lieut. Gen.) H. H. Arnold. Some of its elements went back to the victorious climax of the World War I at St. Mihiel and Meuse-Argonne. Gen. Arnold is now commanding general, Army Air Forces, which passed the million mark in November and is now well on the way to more than double that figure—the most powerful air force the world has ever seen.

The First Wing was later com-



U. S. Signal Corps Photo

Lt. Gen. Frank M. Andrews

USAAF Photo

Col. Hugh J. Knerr

U. S. Signal Corps Photo

Maj. Gen. Follett Bradley

nded by Brig. Gen. Delos C. Emmons, o in 1939 succeeded Gen. Andrews commander of the GHQ Air Force d who became the commanding gen- l of the Air Force Combat Com- nd in 1941 (which succeeded the HQ AF). The first air officer to at- n the rank of lieutenant general, is now commander of the Army De- rtment, air and ground forces, awaiian theater.

The Second Wing had its head- arters at Langley Field where, under e very shadow of the GHQ head- arters, it built up an amazing his- y of achievement through practical perimentation—a veritable proving ground for new ideas, particularly as regards long range bombardment.

The Third Wing, stationed at Barks- dale Field, comprised attack and pur- suit groups (no bombardment). Attack and Fighter aviation was developed at Barksdale, as Bombardment was at Langley.

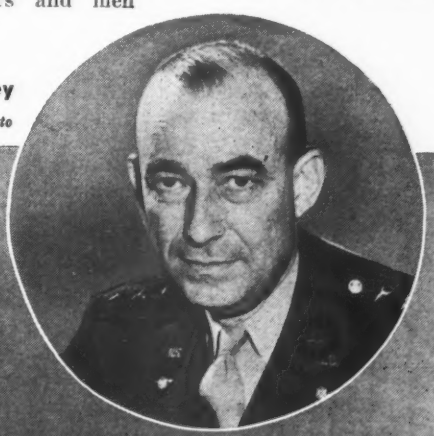
Main purpose of the GHQ Air Force was to coordinate the various systems of air training so as to produce uniformity and the ability to operate together as a team. Another accom- plishment was the later development of the combat crew as a fighting team which could fly, bomb, and shoot. In practice, the same officers and men

USAAF Photo

Lt. Gen. George Kenney

Lt. Gen. Joseph T. McNarney

U. S. Signal Corps Photo



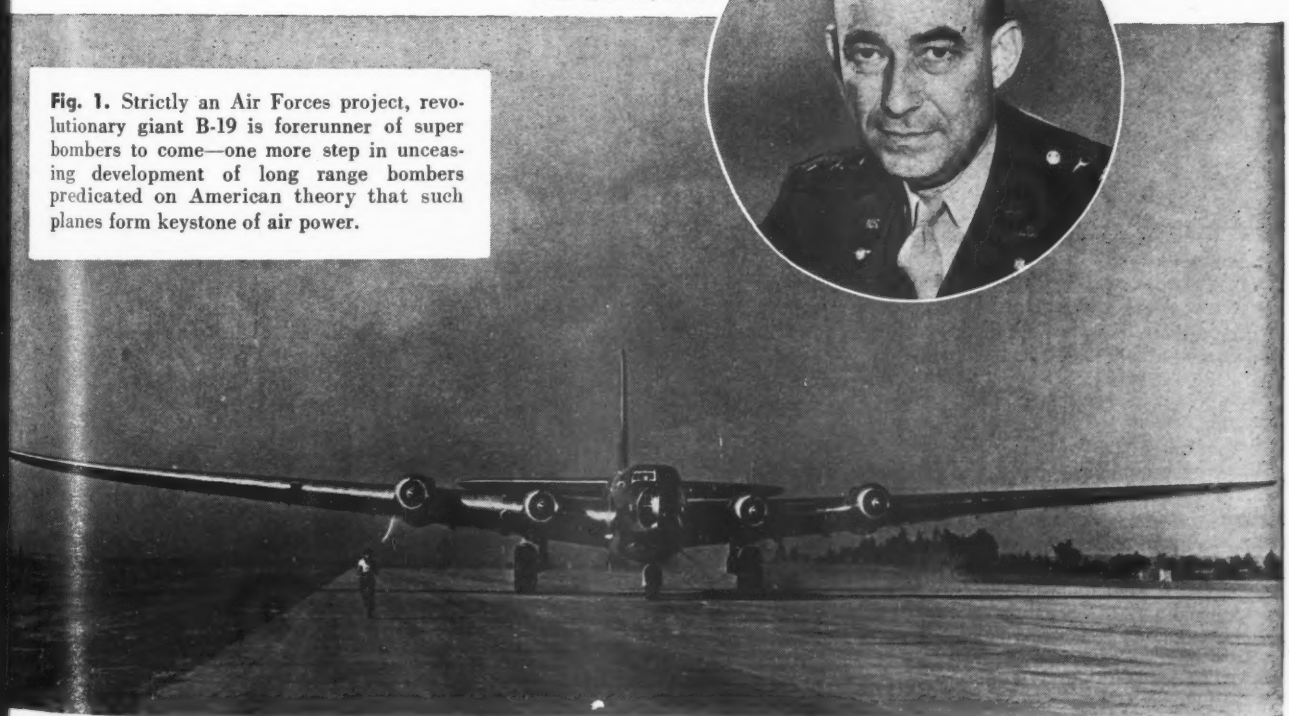


Fig. 1. Strictly an Air Forces project, revolutionary giant B-19 is forerunner of super bombers to come—one more step in unceasing development of long range bombers predicated on American theory that such planes form keystone of air power.

USAAF Photo

Maj. Gen. Robert Olds

USAAF Photo

Brig. Gen. Caleb V. Haynes

U. S. Signal Corps Photo

Maj. Gen. Harold Lee George

USAAF Photo

Maj. Gen. Lewis Brereton

Fig. 2. Dynamic ideas of Army Air Forces have found greatest measure of fruition in electrifying successes of Consolidated B-24 *Liberator* (above) and Boeing B-17 *Flying Fortress* (right). With entire pattern of American entry into world conflict fully and precisely anticipated by GHQ, these heavy bombers were developed as solution to initial threat, for task of rolling attackers back on defensive, and finally to crush enemy at his positions of maximum advantage. Various stages of these concepts in practice are seen in Pacific, where attacking Japanese were finally stemmed and are now being rolled back, and in Africo-European theatre where Germans are already staggering under crushing Allied aerial offensives paced by *Fortresses* and *Liberators*.

were assigned to the same airplan and each team, through constant e operation, was able to attain a hig degree of proficiency.

A Noteworthy Success

Under Gen. Andrews' leadership, i the brief period of four years, the GH Air Force achieved recognition as vital element in our national defens set-up. Highly mobile and powerful, repeatedly proved its ability, in stra tegic tests and maneuvers, to be move quickly from one part of the countr to another, to rendezvous hundreds o miles out to sea in all sorts of weath to break up "enemy" sea borne a tacks, etc. A foundation for America Air Power had been laid at last.

The GHQ Air Force, as we hav seen, became the Air Force Comba Command in June, 1941. And in March 1942, as a result of the reorganizatio and streamlining of the entire Army, was integrated (with the Air Corps which trained the personnel and pro

USAAF Photo

Maj. Gen. Ira C. Eaker

USAAF Photo

Brig. Gen. Willis H. Hale

USAAF Photo

Brig. Gen. Eugene Eubank

USAAF Photo

Lt. Gen. George H. Brett

red the equipment) in the Army Air rces, one of the three grand divisions the Army, co-equal with the Army ound Forces and the Services of pply.

The first four Air Forces cover the its of the continental United States; ers provide for the defense of such al areas as the Canal Zone, Alaska, d Hawaii; and still others are over- s, operating from bases in England, rica, the Middle East, India, China, w Guinea, the Solomons, Australia, d elsewhere, smashing the enemy ere it hurts most. A visit to the Air nference Room for the daily report the Chief of the Air Staff brought the Air Intelligence officers who er each of these areas, illustrated by ge wall maps showing complete de- ls, is convincing testimony that the my Air Forces are pushing ahead ir offensive operations with all pos- le speed. They are fighting on more nts than any other organized mili- y force in the world.

All this is a far cry from 1935. Those were lean days for the Air Forces. Then, the United States ranked fifth in airplane strength among the seven great powers. The order, as it stood on Jan. 1, 1935, is of interest: France, Russia, British Empire, Italy, United States, Japan, Germany. There were already indications that 1935 was to bring out some tremendous surprises in world aviation. Six of the seven powers were making rapid strides in an international race for supremacy in both commercial and military aviation. Germany and Russia emerged as serious contenders

(*Turn to page* 405)

Fig. 3. So-called "medium" bombers figure very largely in American concept of long-range air warfare. Having range and striking power comparable to most nations' heavy bombers, these high-speed, versatile craft perform great variety of missions. Especially adapted to capitalizing on element of surprise, they are noted for dealing heavy blows to an enemy caught unawares, for smashing of lines of supply, and for follow-up raids calling for continuous day and night attack. North American B-25 *Mitchell* (left) and Martin B-26 *Marauder* (above) are representative of this class of bomber.

Financial Outlook For the Aviation Industry

By H. L. FEDERMAN

THE AVIATION INDUSTRY is well on its way toward making 143 a very eventful year.

Aircraft production will be one of the key factors in assuring victory for our arms—possibly this year—almost certainly during 1944. Accomplishments of the aircraft builders have been so heralded at every turn that the citing of percentage increases in terms of production, plant space, workers, and in other forms, has lost something of its former impressiveness.

It is well, however, to maintain a proper perspective of the industry's growth. This can best be done by examining the dollar value of output in airframes, engines, and propellers for the last seven years, as presented in the following tabulation:

1936	$77,000,000
1937	115,000,000
1938	125,000,000
1939	225,000,000
1940	544,000,000
1941	1,750,000,000
1942	4,500,000,000

Goal for 1943 is double the number of planes of 1942, and expectations are that a production value of $10,000,000,000 will be attained. This, of course, if all necessary material and parts are obtained and if no labor shortages interfere.

In the face of the industry's astounding production performance, considerable amazement prevails as to the sorry behavior of aircraft equities. A few representative examples will illustrate the fluctuating fortunes of the industry as expressed by the market.

Table I shows how poorly aircraft stocks have fared since Sept. 1, 1939, the date of the outbreak of war, and up to the close of 1942.

For example, all four issues sampled made their highs in April or May of 1940 and established their lows in May or June of 1942. The year-end of 1942 saw prices very close to these lows. All issues were cut in price by at least one half of their high marks.

This action has been a distinct surprise to those speculators, investors, and observers who remember the market action of the war babies during the days of World War I when, for example, Bethlehem Steel skyrocketed to $700 from $50 per share.

Market experiences at the time of World War I and actual current production records of the aircraft industry itself present a strange anomaly to the recent disfavor which has been the lot of aircraft equities.

The simple and convincing explanation lies in the fact that there has been no profiteering in aircraft manufacture or in the production of any instruments of war. At least, not for long. If anything, the aircraft builders have leaned over backwards in keeping their profits on war contracts at low levels and have been more concerned with turning out planes.

Full impact of taxes has had its effect in reducing aircraft profits to low levels. Further, the continuing process of contract renegotiation has served to confine gains within bounds.

All this has been fully discounted and of late there have been increasing indications of strengthening market values for aircraft issues. Considerable substance for this action is found in underlying factors.

Clearer understanding of tax liabilities has invariably caused upward revisions of previously estimated earnings which will undoubtedly be borne out by the actual reports upon their release.

The tax bogey was laid to rest with the passage of the 1942 revenue act. Somehow, it turned out to be less severe than was originally supposed. It is true that new and onerous tax demands will be made as a result of the fiscal requirements of the current budget. The aircraft industry will carry its share, but it is an established fact that t market never discounts the same pos bility twice. It only need be recall that it was the constant fear of "crus ing" taxes that kept pushing aircra values to lower levels during the great part of 1942.

Regardless of how huge the new t measure may be, it is unlikely that will be enacted in such form as to co pletely confiscate aircraft earning Moreover, the processes of enacting tax bill are long and intricate. Fir the House Ways and Means Committ will conduct involved hearings an come up with its ideas for a tax la Then the Senate Finance Committ will toy with the bill for awhile, goi through the same time-consuming pr cedures. And after that the Sena and House, respectively, will be aske to accept a much-compromised measu

Unless Congress changes its pa habits, it will be many months befo the 1943 tax law may be placed on t statute books. Until that time, it w be highly academic and meaningless attempt to evaluate the full extent the forthcoming tax bill on the aircra industry.

For practical purposes, certainly a market factor, the tax equation known and fully discounted.

The process of contract renegoti tions, in many instances, is approachi completion and making possible est mates of earnings. While these pr jections are necessarily tentative an somewhat premature for 1943, there a tendency for the optimistic side be favored.

Actual operation of the contract r negotiation law has been very encou aging, on the whole, to the aircra builders. This was a very much mi understood measure which at one tim was highly suspect.

It may be recalled that back in Apr 1942, the President signed Public La 528, known as the Sixth Supplement National Defense Appropriation Ac 1942. Among other things, it ma provision for the principal munitio procurement agencies to insert, in an contract for more than $100,000, a pr viso that the contract price could renegotiated at a time when profi could be determined with more reaso able accuracy.

(*Turn to page* 422)

TABLE I—MARKET RANGE OF SELECTED AIRCRAFT STOCKS

	High		Low		1942 close
Douglas Aircraft...	95	May, 1940	51	May, 1942	5
Lockheed Aircraft..	42	Apr., 1940	15	May, 1942	16
Glenn L. Martin...	48	Apr., 1940	17	May, 1942	18
United Aircraft....	53	Apr., 1940	24	June, 1942	25

NOTE: All prices adjusted to nearest dollar unit.

TABLE II
BARRON'S STOCK AVERAGES

	Aircraft	Air Transport	50 Stocks
Jan. 8, 1943.....	27.80	28.69	69
Dec. 31, 1942.....	27.38	29.19	69
Dec. 24, 1942.....	27.62	*29.91	68
Dec. 17, 1942.....	27.88	28.19	67
Jan. 9, 1942.....	34.28	19.56	64
1942 High.....	34.38	29.91	69
1942 Low.....	25.70	13.44	60

* New high for 1942.

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At lower altitudes, control of expansion is a relatively simple matter. But as the troposphere and stratosphere are reached, each 1,000 feet of climb multiplies rapidly the problem of precise barometric measurement and temperature compensation.

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Transportation In the Postwar Period

By A. N. KEMP

President, American Airlines, Inc.

Much of our country's influence at the peace conference will depend on the strength of our air transport system. And in the final analysis, the size and scope of that system will be determined by the people.

TRANSPORTATION in the postwar period is a subject which is vital to all of us—to our industrial, economical, and cultural lives. Perhaps, most of all, the development of our airlines will be vital to the role our nation is to play among nations when the time comes for us to sit around the peace table with our victorious allies.

Change is a certainty. For change, despite the fact that it has often taxed man's credulity and often been retarded, has never been stopped. Today's changes, hastened by a war, are in high gear. Therefore the need is greater for the benefit of perspective. To avoid mistakes of commission or of omission, we must approach our near-future transportation problems in the light of history. A dependable evaluation of technological advancements must include an understanding of human nature. Man has two aspects, his measurable physical and his immeasurable metaphysical. It is the latter that survives all physical changes.

All that has been learned of our physical world and of the forces of nature has been acquired despite tradition and habit and despite the testimony of man's senses. Man once thought the world flat because that is the way he saw it. He thought the sun moved around the earth, and that the earth was stationary instead of moving much faster than sound—because that was the way he saw it. Man thought his means of access to his fellows was only by land or sea—because that was the way he saw it. But what changes have been brought about from time to time in our world economy through the discovery of the facts about these matters!

Because air is invisible, it is difficult for man to "see" it. Yet, it is the use of air as a realm for transportation, more than any other physical factor, which makes this a global war. By transportation we mean the movement through the air of any or all things, whether combat personnel, mobile guns, messages, or cargoes. The trenches of World War I could have all been dug in the single state of California. But World War II is everywhere, actually or potentially, for the basic and elementary reason that *air* is *everywhere*.

Perhaps the best illustration of our concept of today's changed air-world is the accompanying "air map" which has already aroused considerable comment. It is a polar projection map which omits all demarcation of the earth's land and water divisional lines, showing nothing but the names of places in their proper locations. Gone are the boundaries between our own states, gone the map-lines that separate our continental nation from the Atlantic and the Pacific and from Canada and Mexico. Gone are those great barriers along our coasts—the oceans. These surface omissions provide the dominant factor to weigh in any postwar transportation planning, because the proximity of places, and their effective relationships, are completely changed by the airplane.

IT IS SAID man has been upon earth two million years. Always it has been necessary for him to combat the elements of nature. We can visualize the needs of primitive man as being primarily food, shelter, and protection of his body. Then came the knowledge that he could not remain rooted in one spot, as does a tree, and bear fruit. For immobility spells death to the human being. All through the years of man's existence upon earth there has been a compulsion to travel. Adversity as well as opportunity spurred man to seek and obtain those things necessary for his survival and growth. Transportation, therefore, is a very old problem. As man developed and his needs became more diversified and complex, he became increasingly dependent upon better methods of transportation. At various stages down through the centuries, the mind of man has been challenged by new discoveries and inventions that change the meaning of time and reduce the obstacles of space. This process has been termed the age-old search for the longer hour and a shorter mile.

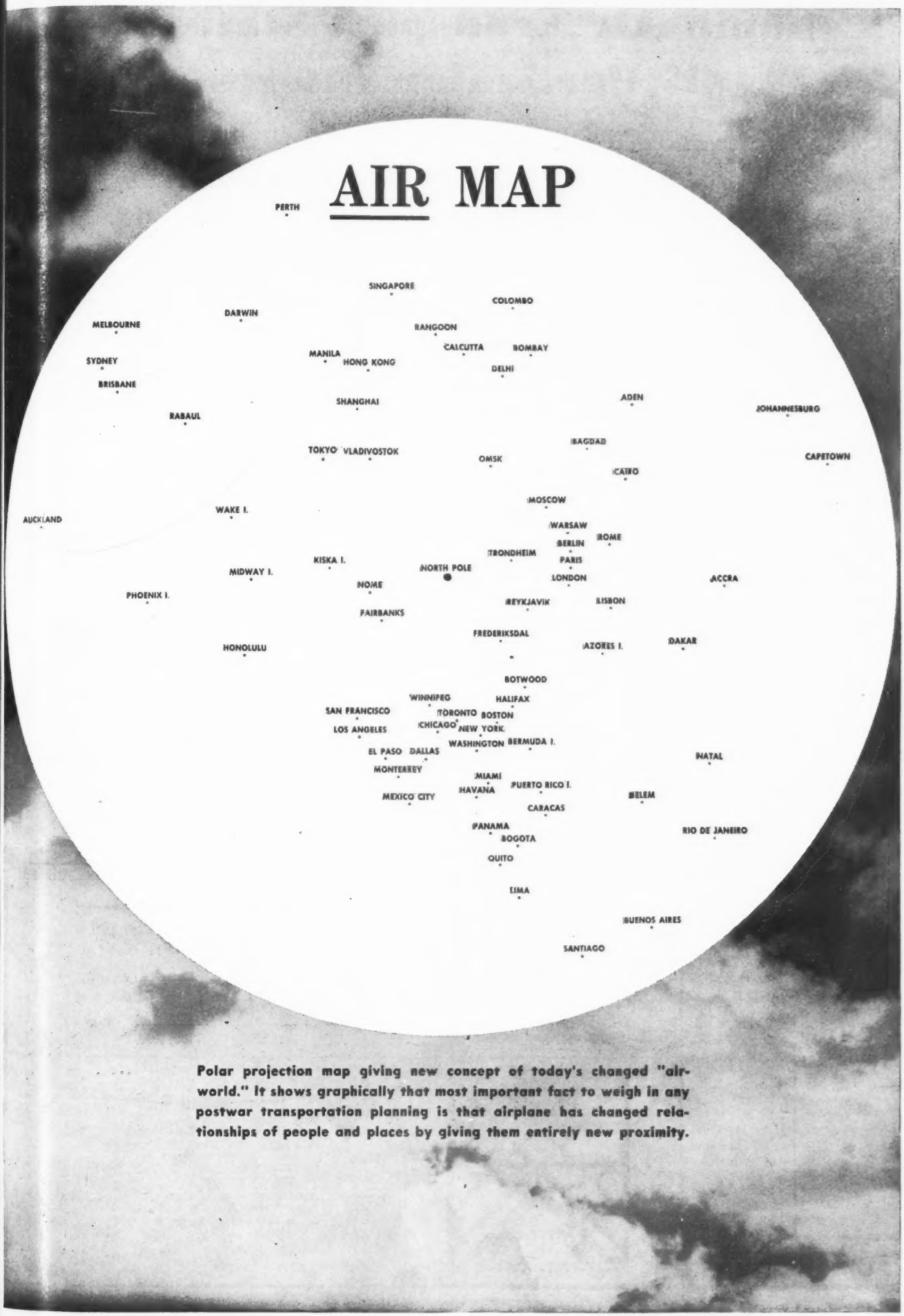
In the path of irrevocable change, man cannot remain neutral. Every epochal period of improved transportation has affected all men, both those who adopted and used the new and those who rebelled and clung to the past. For the former it was a new dawn; for the latter, the beginning of the end. Our contemporary, postwar problem, serious as it is, is another chapter in the serial of the centuries.

History will repeat. Most will go forward with it; some will go down under it. In those respects, our age and our generation are no different from any of the countless ones in the world's past. And today we in America are faced with perhaps the greatest of all epochal transportation changes.

WITH this viewpoint in mind, the editor of AVIATION made a Gargantuan request. That is because methods of transportation per se are not ends unto themselves; they are "the means toward many ends". Time and distance always have imposed obstacles upon "the productivity of our resources" and upon all economic and cultural advancement. As each new method of transportation has made possible more than its predecessor, it also increased the *volume* of traffic. It opened new horizons and created new *problems*. That, we believe, is what the National Resources Planning Board had in mind when it reported to the President that "No 'final' solution will ever be achieved."

That still would be true even if we did not have aviation today. But with today's and tomorrow's ships-of-the air as a new, third-dimensional factor, we believe the whole subject of transportation is in for the greatest change, in the shortest span of time, in all history. Therefore I shall not attempt to discuss individually all forms of transportation in our postwar period—air, rail, motor, water, or pipe line. Suffice it to say that the inhabitants of this earth have spent countless centuries endeavoring to improve old, and invent new, methods of *surface* transportation. Consequently, the public has more un-

(*Turn to page* 417)



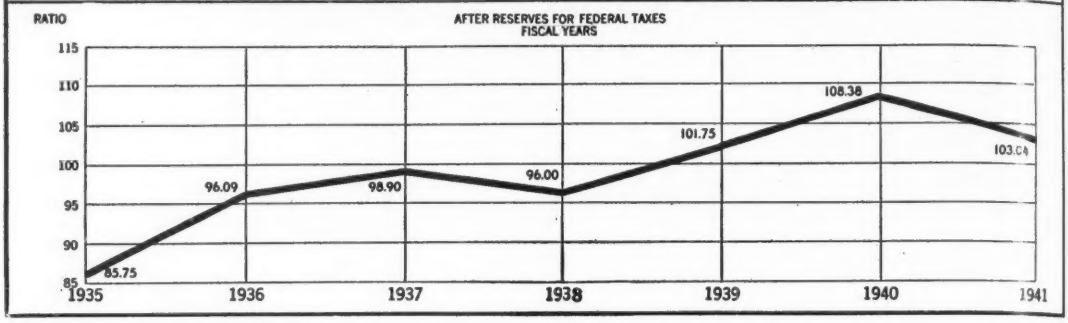
Polar projection map giving new concept of today's changed "air-world." It shows graphically that most important fact to weigh in any postwar transportation planning is that airplane has changed relationships of people and places by giving them entirely new proximity.

Some Air Transport Statistics Of Particular Interest

To Investors

DOMESTIC

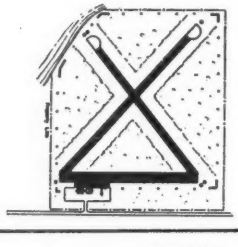
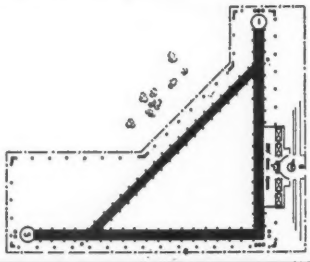
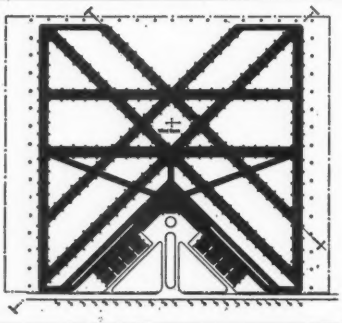
RATIO OF REVENUE TO OPERATING EXPENSES *Source: Carriers Annual Reports*



To the Construction Industry

TENTATIVE CLASSIFICATION OF AIRPORTS

SOURCE: AIRPORT DIVISION - CIVIL AERONAUTICS ADMINISTRATION

AS OF July 1, 1941	AS OF Jan. 1, 1942	
1,567	1,523	**CLASS 1** — SMALL PRIVATE OWNER TYPE AIRCRAFT. 2 TO 5 PLACE. ADEQUATE FOR AIRCRAFT UP TO 4,000* GROSS WEIGHT. FOR SMALL COMMUNITIES AND SECONDARY AIRPORTS. LANDING STRIPS 1800' TO 2500' LENGTH.
543	702	 **CLASS 2** — LARGER SIZE PRIVATE OWNER TYPE AIRCRAFT AND SMALL SIZE TRANSPORT AIRCRAFT. UP TO 20 PLACE. ADEQUATE FOR AIRCRAFT FROM 4,000* TO 15,000* GROSS WEIGHT. COMMUNITIES OF 5,000 TO 25,000 POPULATION. LANDING STRIPS 2500' TO 3500' LENGTH.
121	186	 **CLASS 3** — PRESENT DAY TRANSPORT AIRCRAFT. UP TO 30 PLACE. ADEQUATE FOR AIRCRAFT FROM 10,000* TO 50,000* GROSS WEIGHT. CITIES OF 25,000 TO 250,000 POPULATION ON AIRWAYS SYSTEM. LANDING STRIPS 3500' TO 4500' LENGTH
46	72	 **CLASS 4** — LARGEST AIRCRAFT NOW IN USE AND THOSE PLANNED FOR IMMEDIATE FUTURE. 50 PLACE AND LARGER. ADEQUATE FOR AIRCRAFT OF GROSS WEIGHTS OF 50,000* AND OVER. MAJOR METROPOLITAN CENTERS AND AIRWAY TERMINALS. LANDING STRIPS 4500' LENGTHS AND OVER
Total		
2,277	2,483	

This presentation adopted from charts in Air Transportation Association's booklet, "Little Known Facts". Copies on request to AVIATION.

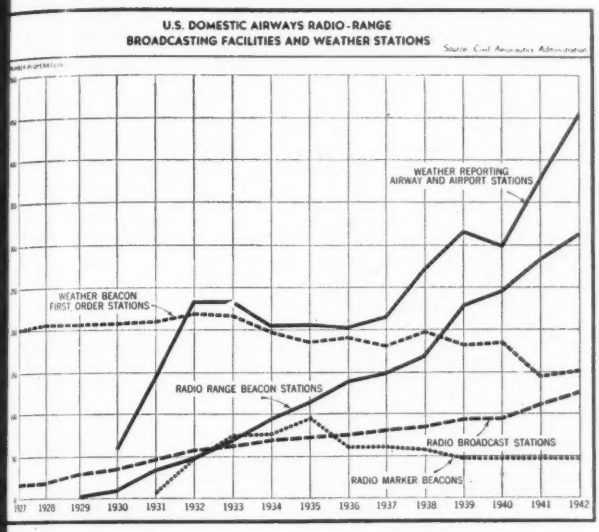
...the Transportation Industry

In May, 1942, the airlines of the United States were operating a fleet of 324 airplanes. By the end of 1942, this fleet consisted of but 166 airplanes. With this fact in mind, the following figures covering this period of decreasing available equipment are especially significant.

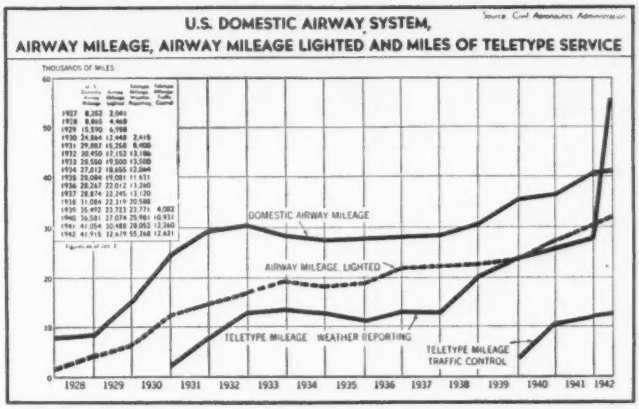
	Year 1941	Year 1942*	Percent Change
Passengers carried.....	4,060,545	4,446,297	+9.5%
Passenger miles flown...	1,491,734,671	1,700,577,524	+14.0%
Revenue miles flown....	133,022,679	126,200,000	−5.0%
Express pound-miles....	10,485,058,005	13,630,575,406	+30.0%
Express pounds carried.	19,209,671	40,340,319	+110.0%
Air Mail, pound-miles...	25,648,651,008	39,345,030,646	+53.4%

*Estimates for 1942

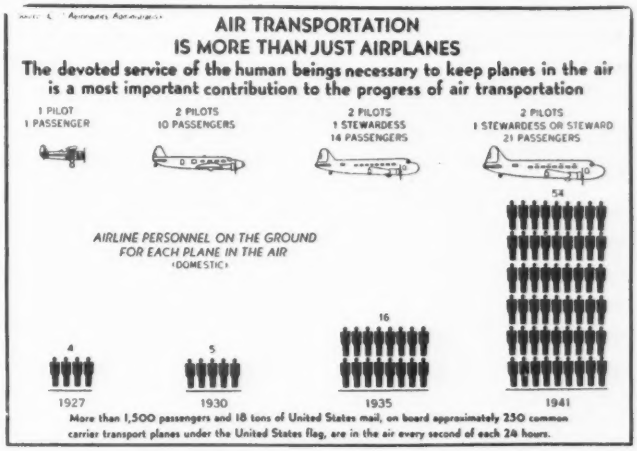
...the Radio and Electronics Industry


U.S. DOMESTIC AIRWAYS RADIO-RANGE
BROADCASTING FACILITIES AND WEATHER STATIONS
Source: Civil Aeronautics Administration
WEATHER REPORTING AIRWAY AND AIRPORT STATIONS
WEATHER BEACON FIRST ORDER STATIONS
RADIO RANGE BEACON STATIONS
RADIO BROADCAST STATIONS
RADIO MARKER BEACONS
1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942

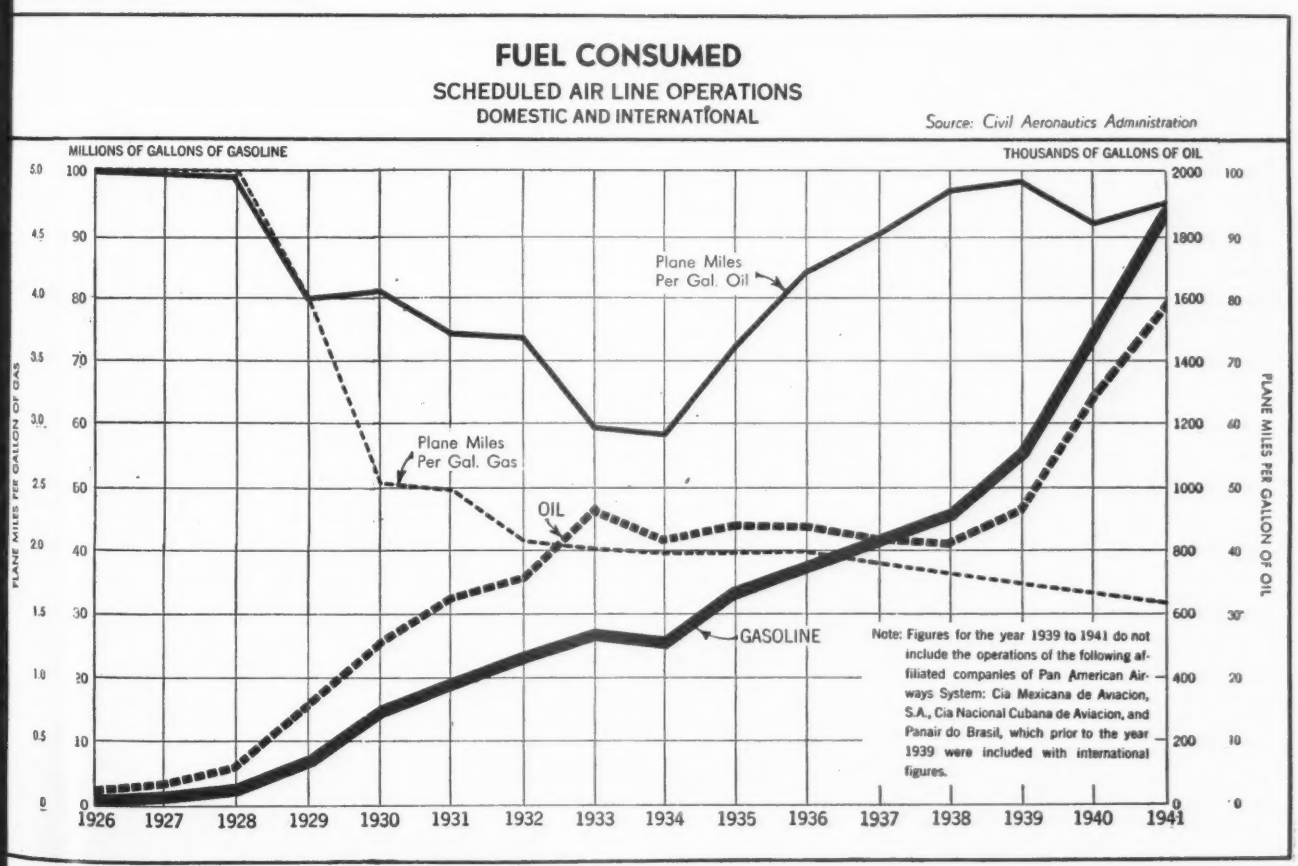
To the Lighting and Electrical Industry


U.S. DOMESTIC AIRWAY SYSTEM,
AIRWAY MILEAGE, AIRWAY MILEAGE LIGHTED AND MILES OF TELETYPE SERVICE
Source: Civil Aeronautics Administration
THOUSANDS OF MILES
DOMESTIC AIRWAY MILEAGE
AIRWAY MILEAGE LIGHTED
TELETYPE MILEAGE WEATHER REPORTING
TELETYPE MILEAGE TRAFFIC CONTROL
1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942

To Everyman, particularly Air Forces Personnel

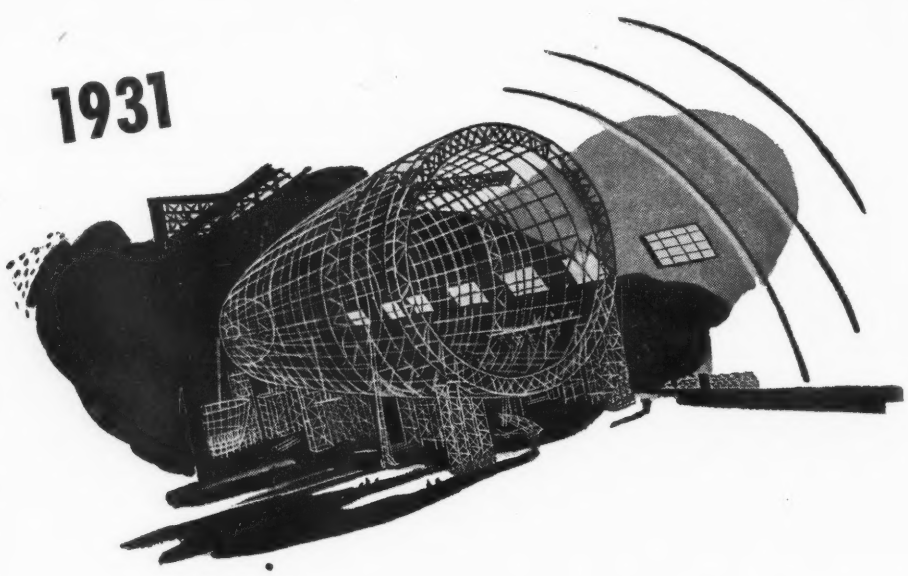

AIR TRANSPORTATION
IS MORE THAN JUST AIRPLANES
The devoted service of the human beings necessary to keep planes in the air is a most important contribution to the progress of air transportation
1 PILOT 1 PASSENGER
2 PILOTS 10 PASSENGERS
2 PILOTS 1 STEWARDESS 14 PASSENGERS
2 PILOTS 1 STEWARDESS OR STEWARD 21 PASSENGERS
AIRLINE PERSONNEL ON THE GROUND FOR EACH PLANE IN THE AIR (DOMESTIC)
4
5
16
54
1927
1930
1935
1941
More than 1,500 passengers and 18 tons of United States mail, on board approximately 230 common carrier transport planes under the United States flag, are in the air every second of each 24 hours.

...the Petroleum Industry


FUEL CONSUMED
SCHEDULED AIR LINE OPERATIONS
DOMESTIC AND INTERNATIONAL
Source: Civil Aeronautics Administration
MILLIONS OF GALLONS OF GASOLINE
THOUSANDS OF GALLONS OF OIL
PLANE MILES PER GALLON OF GAS
PLANE MILES PER GALLON OF OIL
Plane Miles Per Gal. Oil
Plane Miles Per Gal. Gas
OIL
GASOLINE
Note: Figures for the year 1939 to 1941 do not include the operations of the following affiliated companies of Pan American Airways System: Cia Mexicana de Aviacion, S.A., Cia Nacional Cubana de Aviacion, and Panair do Brasil, which prior to the year 1939 were included with international figures.
1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941

Trail Blazing in the Skie

1931



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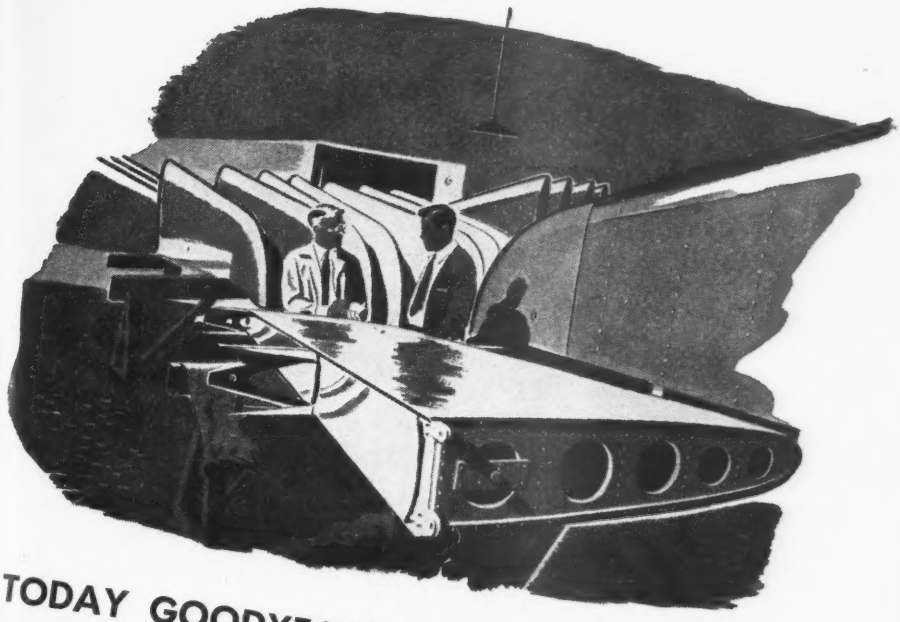
2. *By designing parts for all types of planes.*

3. *By re-engineering parts for mass production.*

4. *By extending our research facilities to aid the solution of any design or construction problem.*

1943

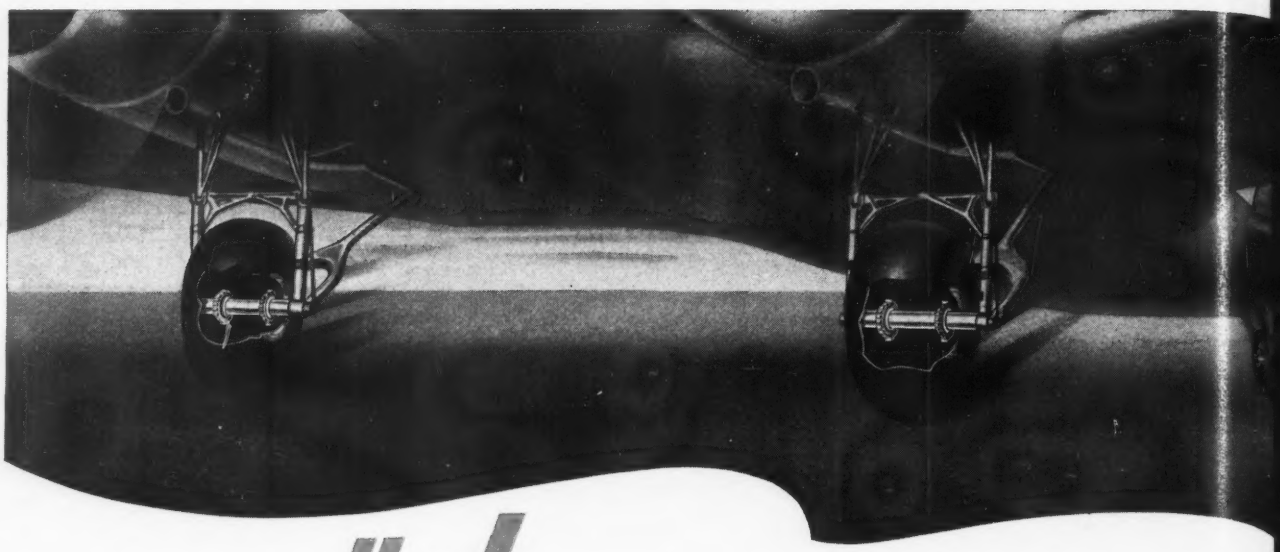


TODAY GOODYEAR'S SKILL IN DURALUMIN FABRICATION is helping many of America's most famous airplane manufacturers meet their wartime production schedules. For these companies we are mass-producing wing and tail subassemblies, control surfaces, fuselage and cabin sections. All this is in addition to Goodyear's own production, as a primary contractor, of both complete airplanes and airships for the United States Navy.

GOODYEAR

GOODYEAR

AIRCRAFT



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Maximum capacity in the minimum of space has been the forte of the Timken Bearing wherever wheels and shafts turn in whatever industry. In the aviation industry this outstanding characteristic of the Timken Bearing has perhaps more significance, greater importance than in any other. Make sure the wheels you build or buy are Timken Bearing Equipped. The Timken Roller Bearing Company, Canton, Ohio.

"All There Is **TIMKEN** In Bearings"

TRADE-MARK REG. U. S. PAT. OFF.

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Manufacturing Section of AVIATION

PRODUCTION
DESIGN • RESEARCH
ENGINEERING

More Wings for *Airacobras* By Conveyor Production . . *Carl F. Loson* 126

Aviation's Sketch Book of Design Detail

Cutaway of North American P-51 *Mustang* . . 147
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Crankcase details of Daimler-Benz DB-601 . . . 149
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More Wings For Airacobras

. . . By Conveyor Production

By CARL F. LOZON
Assistant Works Manager, Bell Aircraft Corp.

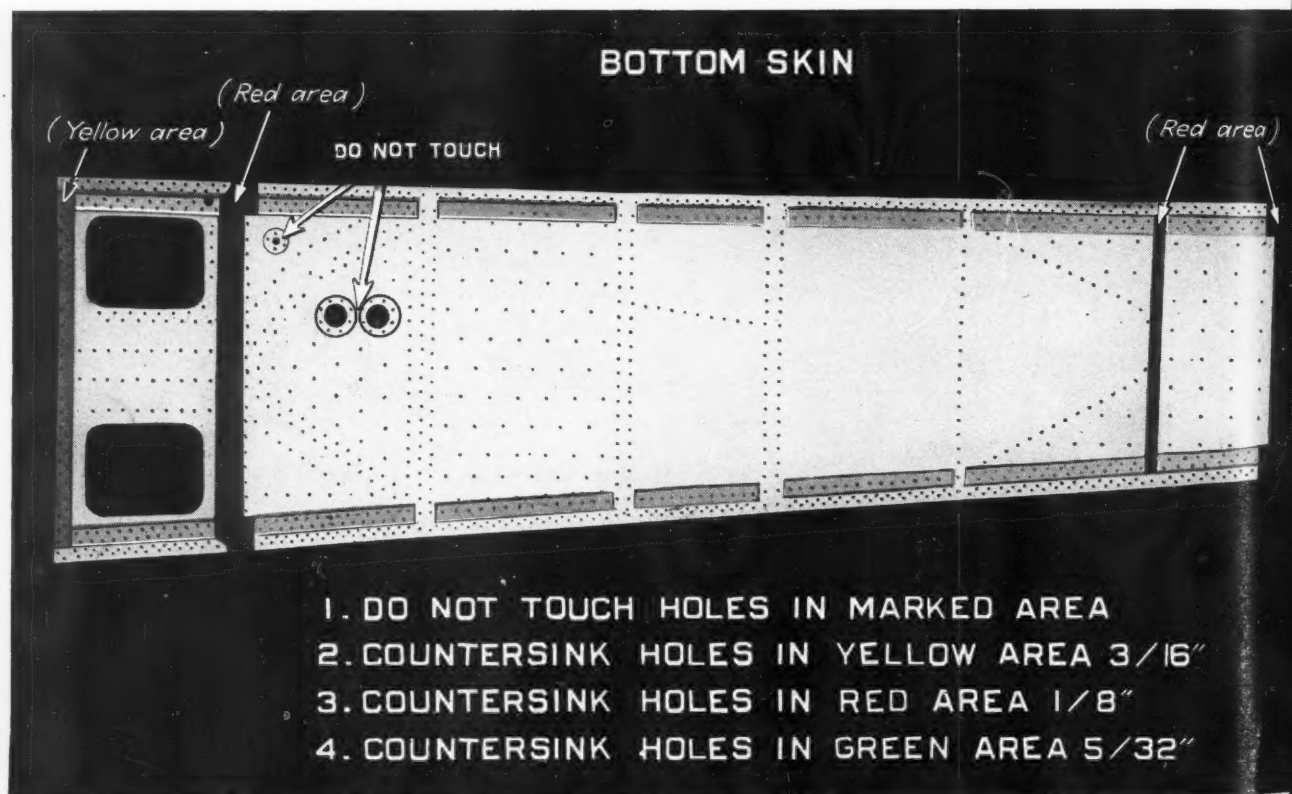
Constant motion production lines—not mere assembly lines—enable unskilled women workers at Bell Aircraft Corp. to build complete wings in unprecedented numbers. Fixture design and layout cut production time

CONSTANT MOTION ASSEMBLY LINES have been used to an increasing extent for almost two years by the nation's aircraft industry. But, as the phrase implies, the work done on these lines for the most part consisted of attachment of parts and installation of electrical and hydraulic systems. In the adaptation of assembly lines for the aircraft industry's use, Bell Aircraft Corp. was a pioneer, applying constant motion to its fuselage assembly lines in the spring of 1941.

Now, another important stride has been taken with respect to the use of constant motion lines, again by Bell Aircraft. It is the development of system whereby wings for Army A *cobras* are actually fabricated progr sively on a link-belt power-driven c veyor. Bench work and machine w on subassemblies are accomplis parallel to the line and synchronized its forward motion. This improvem is not something in the blueprint st It is actually operating—and very s cessfully.

There are absolutely no tool bo power lines, outlets, or connections floor, dollies, or work stands. Rec tacles are provided, conveniently s pended from overhead bridging, which drills, rivet guns, and all po operated tools are attached at work height, thus eliminating much confus and hazard, conserving rubber critical materials by greatly prolong the life of lines and fittings. This reduces workers' fatigue, resulting f stooping and lifting. All operations planned for maximum simplificat each one clearly explained in minu detail by words and pictures—right the line—so the greenest operator scarcely go wrong.

Result: Efficient wing fabricatio accomplished by women operat (eventually 100 percent women—exc for a few leadmen who also may be placed by women). And these are women with a background of experie and extensive training; many of th


BOTTOM SKIN
(Red area)
(Yellow area)
DO NOT TOUCH
(Red area)
1. DO NOT TOUCH HOLES IN MARKED AREA
2. COUNTERSINK HOLES IN YELLOW AREA 3/16"
3. COUNTERSINK HOLES IN RED AREA 1/8"
4. COUNTERSINK HOLES IN GREEN AREA 5/32"

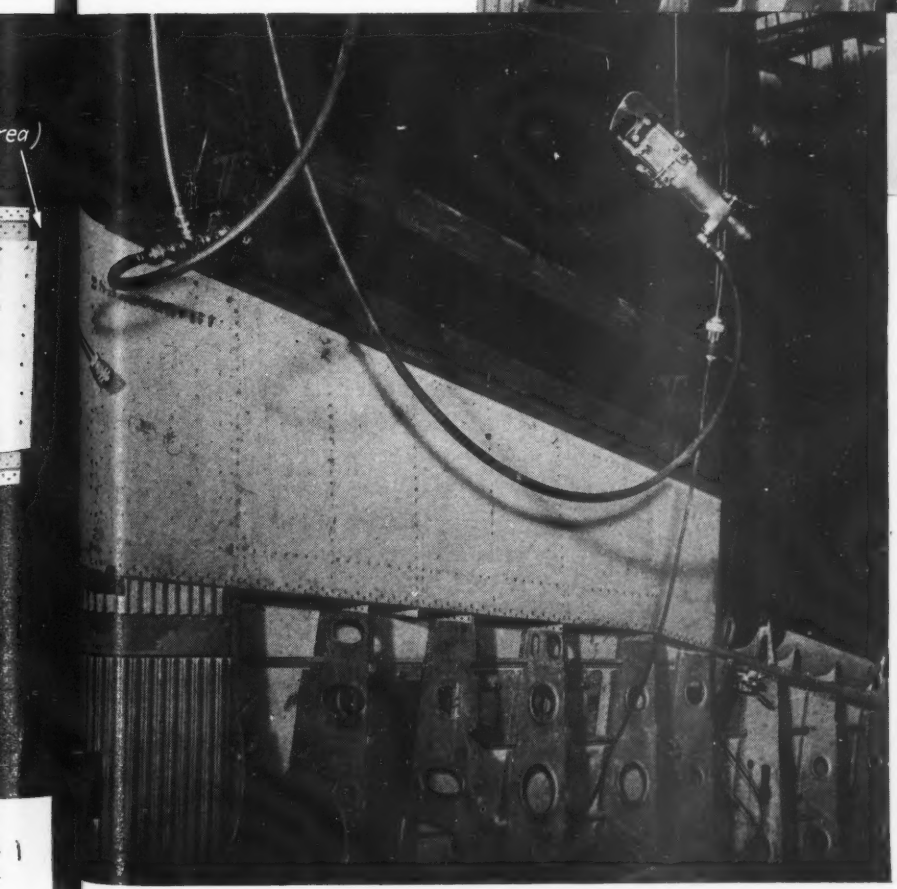
1 **Typical work simplification development** at Bell Aircraft. Distinctive colors are used to distinguish areas receiving identical operations. By referring to chart, operator can immediately determine correct tool and size.

few short weeks ago, were seamsses, housewives, and school girls. thods, engineering, planning, and an tensive industrial training program de this possible.

Arrangement of the wing department be seen at a glance by referring to reverse side of the fold-in accomying this article. This department mpies in the Bell Buffalo plant one tremely large bay and half of the jacent bay. Here there are powererated drag chain lines extending m a transfer area at one side of the ilding nearly to the opposite side. smaller bay is given over to fabriion and assembly of the front and r beam, the leading edge, trailing ge, and auxiliary beam, necessarily mplished before those parts join production line.

Minimum of Obstacles

The whole layout of the wing line s so designed as to place a minimum obstacles on or above the floor and require a minimum disturbance of existing floor and foundation. Deils of the drag chain installation, nsfer cars, and track for the fixturelies are largely explained in the wings on page 6. Briefly, motors l gearing for the chains are housed overed pits at the power end of each . A smaller pit at the opposite end ses the sprocket for the return loop.



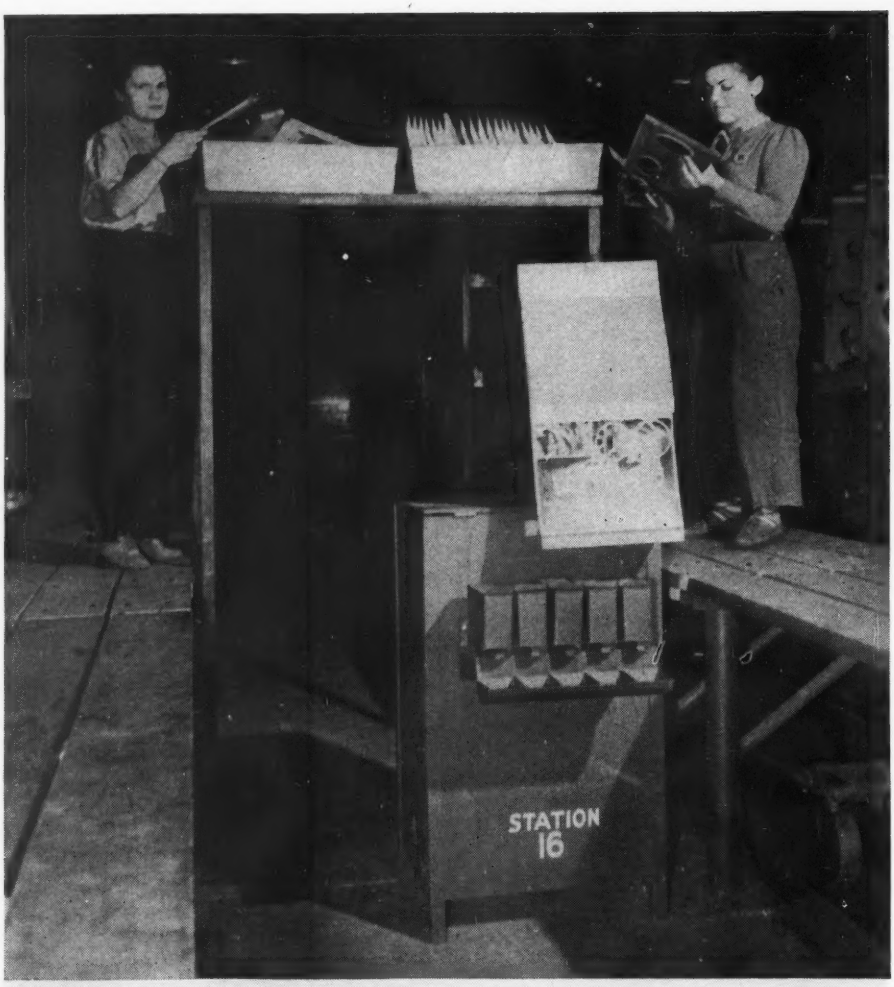
2 All electric and air-operated tools are suspended from automatic reels, remaining at whatever height released. Relieves operator of much unnecessary fatigue. Keeps floor, work, and platforms clear of tools and lines.

This has been made adjustable to take up slack.

Transfer areas at either end of the line necessitate a slight depression in the floor. The track and chain supports are attached directly to the surface of the floor without requiring any excavation or disturbance of the flooring other than placement bolts. The drag and return chain ride in two channels, one above the other. However, since this is directly under the base of the fixture it constitutes no hazard.

Fixture Features

Combination fixture-dolly rides on three wheels. They are all free swiveling castors, but the tail wheel is grooved and rides on an inverted angle iron welded to the base plate beside the chain support. The two outer wheels ride on flat plates laid on the cement floor and are kept in position by the locking device at the forward end of the fixture which engages the drag chain.



3 Along section of line where work is high, bridges between platforms provide both convenient parts racks and guard rails. Cabinet holds all tools required at station; cans on side dispense rivets. Note graphic operations sequence charts.

The fixture itself, illustrated on pages 129-130, incorporates many unusual features. The frame of the fixture is made of welded black iron pipe. The base is formed by an 8-in. main beam extending the full length of the fixture. This beam is crossed by a smaller pipe at the forward end, forming a T, with the two outer wheels mounted at the ends of the T-bar. Rising vertically from this T-bar is a ladder to support the end plates which position the wing in the fixture.

Elements Lift Out of Way

Then, at the trailing end of the fixture is a shorter tripod made of 4-in. uprights. From the top of the tripod at an angle upward to the top of the ladder is a long beam forming the top of the fixture. This is a 4-in. pipe with a 5-in. channel welded to it. From this overhead beam are suspended two moving elements—the aileron bracket locating fixture and the slot trailing edge holding device. Both of these elements are lifted out of the way as soon as their function is completed.

A small fish plate for positioning the outer end of the main wing panel is hinged to the main beam at bottom, and a tongue at top mates with a groove on the end of the aileron bracket locating fixture with a removable pin locking them together. When the main wing panel is ready for attachment of the wing tip, the fish plate is swung down and out of the way on its hinge.

Spaced along the main beam are two padded supporting jacks which help carry the weight of the wing panel and protect the leading edge from damage when the panel is being removed from the fixture.

Junctions of the ladder uprights and the main beam with the cross of the T are reinforced with gussets welded in place. To each of the uprights are welded three pads. To each pair of pads is attached a horizontal locating plate, accurately positioned by locating pins and fastened to the pads with two recessed head bolts at either end. The bolt holes in the locater plates to which the wing bulkhead is fastened are matched from the master fish plate.

After the pads are welded to the uprights of the ladder, the bases are ground to a plane flat within 0.004 in. This was accomplished by attaching the grinder ways directly to the ladder, thus assuring that all of the pads were ground on the same plane and to the same depth. The center of the pads were relieved, leaving only the narrow edges to be finish ground. The pads are drilled and tapped to receive the bolts holding the end plates in position. Each wing line is broken down into 42 stations. At each station a specific set of operations is performed by operators assigned to that station.

Cabinets a Feature

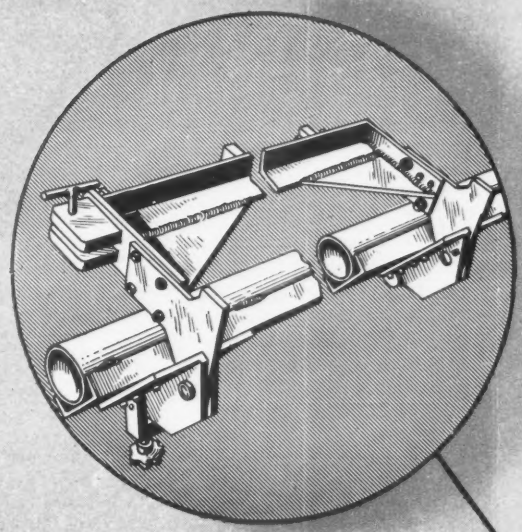
At the end of each station, beside each line, is a cabinet numbered to correspond with the station. It contains all hand tools, jigs, gages, etc., required to carry out operations specified for that station. This makes it unnecessary for any workers to carry tool boxes or hand tools to the line. It also helps diminish the number of tools lost and mislaid. The cabinet serves two other important functions. On one side is a row of ejectors containing various sizes of rivets needed for that station. They are equipped with tilt bottoms which release a convenient handful of rivets when these bottoms struck with the tips of the fingers.

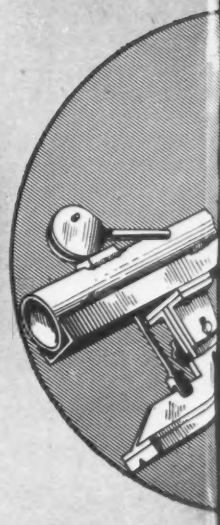
The stand also provides a convenient rack for the photographic operation sheets which carry detailed instructions concerning the correct method of accomplishing each operation and the proper sequence of operations at that station. These operations instruction sheets are similar to those described in the article, Visual Production Training at Bell, by David G. Forman, which ran in the July and August, 1941, issues of AVIATION.

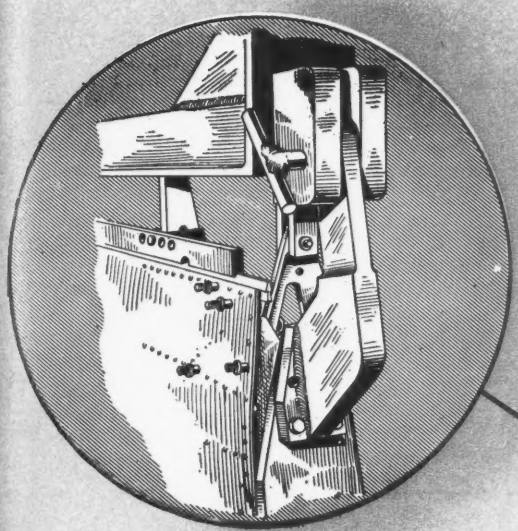
The sequence of operations at each station will be described briefly to demonstrate how the wing is built up in the fixture and finally completed and finished. Two of the lines are devoted to fabrication of right-hand panels and the other two to left-hand panels, so that they are completed in pairs at the end of the line.

As the fixture-dolly is brought down the return line toward the transfer car at the head of the line, the leading edge assembly (see Fig. 5) and the rear beam and spindle bearing assembly are positioned in the fixture. At Station 1, the outer bulkhead and three intermediate bulkheads are fastened in place (see Fig. 6). A dummy door is assembled to front and rear beams with C-clamps and pilot holes drilled (Fig. 8). Plates and filler strips are attached and drilled

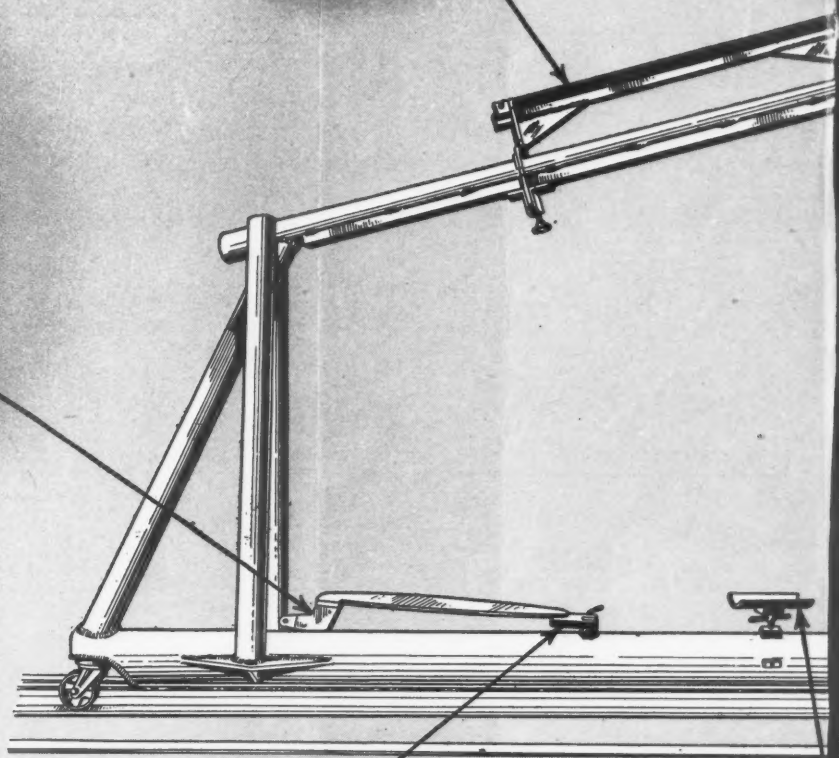
The aileron hinge bracket locator device is constructed so that it may be released and swung up to rest on the top beam out of the way after its function is completed. In the down position, three pronged brackets on the bottom plate of the locator engage the three aileron hinge brackets on the wing (see Fig. 13) and a slotted bar behind the brackets is used to position the trailing edge extrusion riveted between the frieze and top skins. Note screw clamps which lock locator in down position.

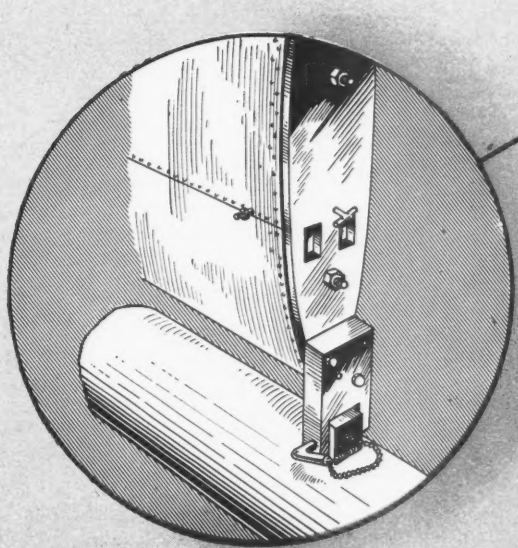




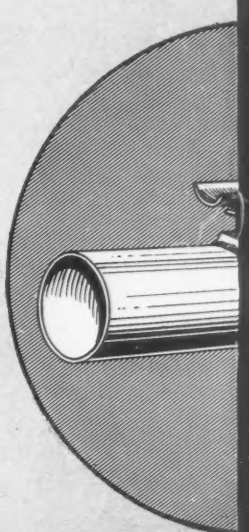


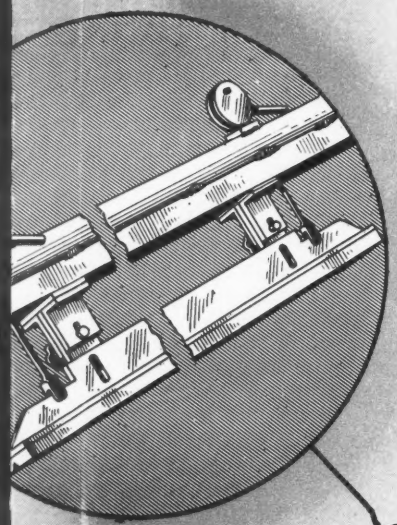
In the initial stages of fabrication, this end plate which aligns the outer bulkhead of the main wing panel is raised to a vertical position. The angular extension enters the slot on the side of the aileron hinge bracket locator suspended from the top beam and is locked in place with a removable pin.



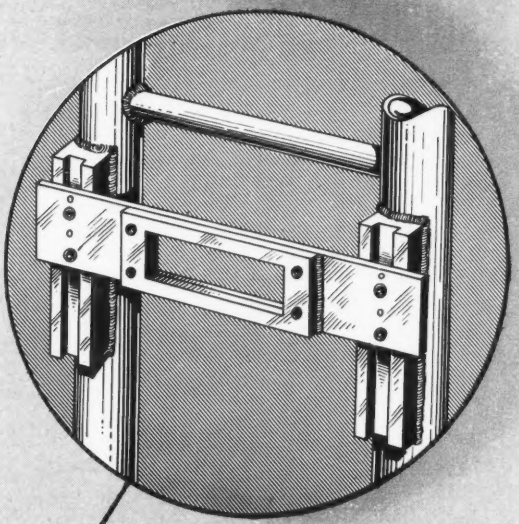


This shows the hinge detail of the outboard bulkhead fish plate in the raised position as seen from the reverse side of the fixture. Note cut-outs in the plate for riveting operations. Bolts are removed and the plate dropped down to the base of the fixture when the wing panel is ready for attachment of the wing tip.

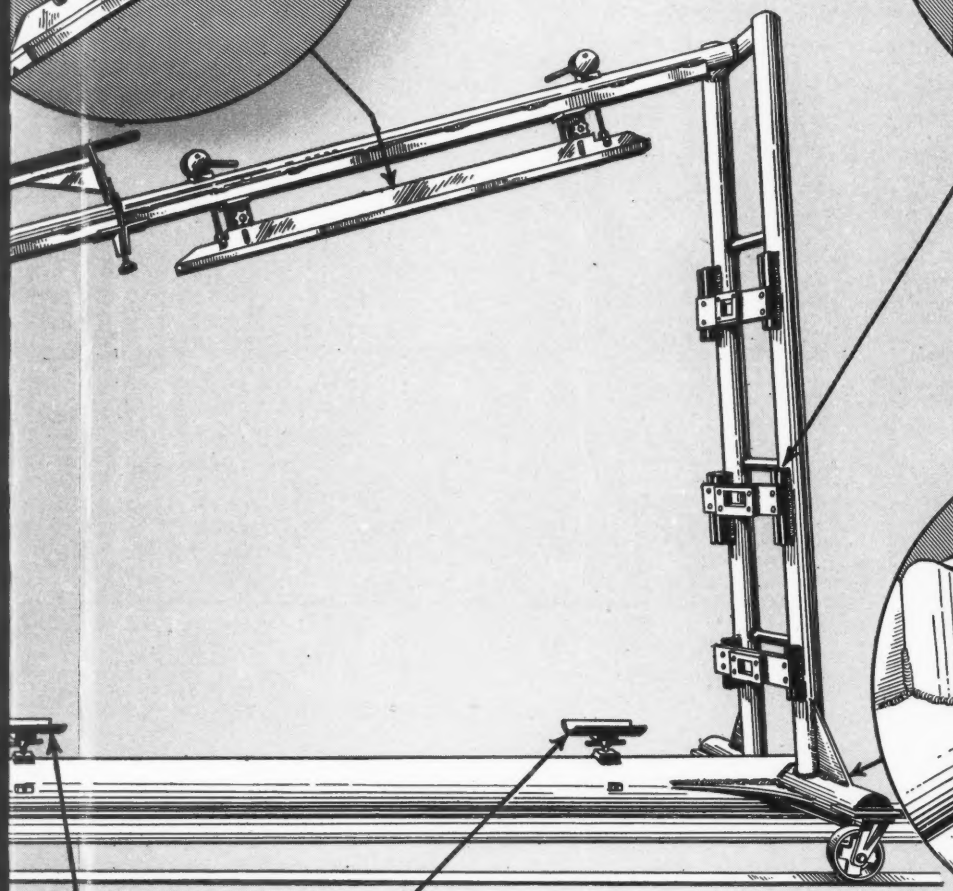


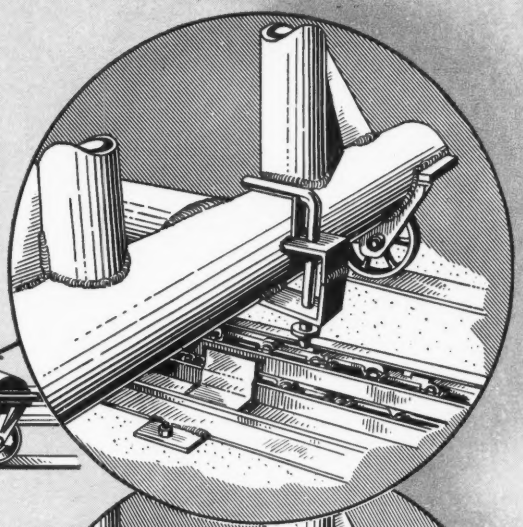


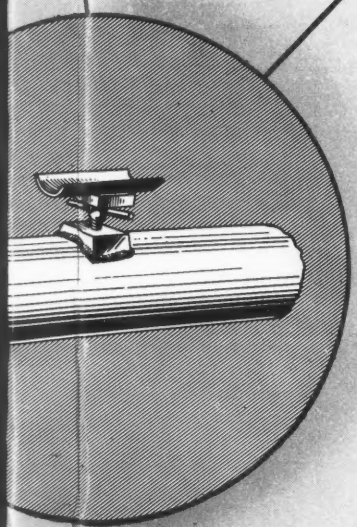
The flap trailing edge locator has two tongues which slide up and down between two pairs of angle brackets attached to the underside of the top beam. It is raised and lowered by the pair of eccentric pivoted lever-operated cams which ride on the pads welded to the top of the beam. Screw clamps on the tongue-and-groove brackets hold the fixture in accurate position.



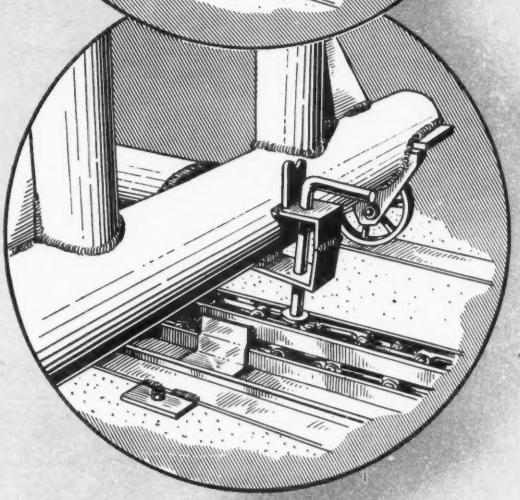
The end plates which position the inboard bulkhead of the wing panel are accurately positioned by means of locating pins and bolted to the pads welded to the uprights of the fixture with recessed-head bolts. This permits completed wing to be swung out of fixture without danger of damage from contact with protruding heads of bolts.







Two detail sketches show the fixture-locking device in engaged and disengaged positions. In the down position, the end of the bar engages a link of the drag chain and the fixture-dolly is pulled forward. This also positions the dolly laterally so that the free casters ride on the flat metal strips.

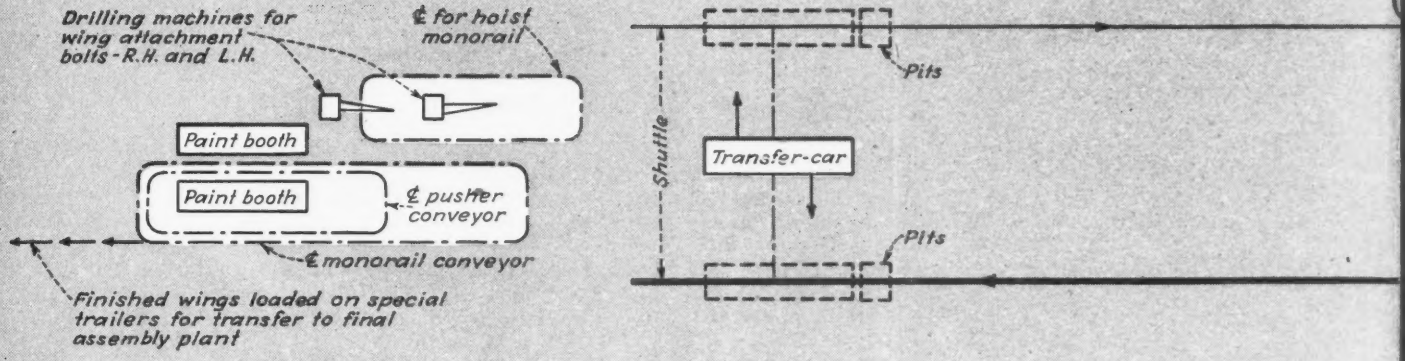


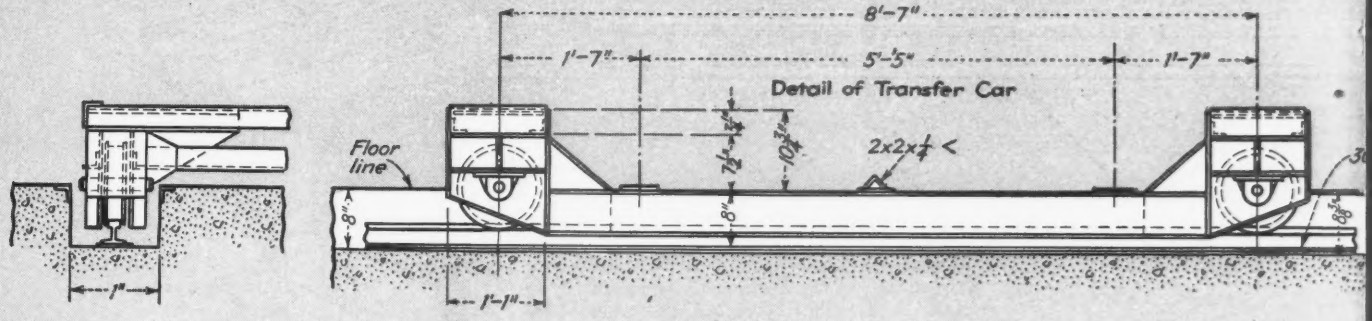
When the leading edge assembly is placed in the fixture, three supporting jacks, suitably padded, are raised into contact with the leading edge. As the wing assembly grows, they assist in supporting the increasing weight and also prevent damage to the leading edge when the wing is unbolted from the end plates and removed from the fixture.

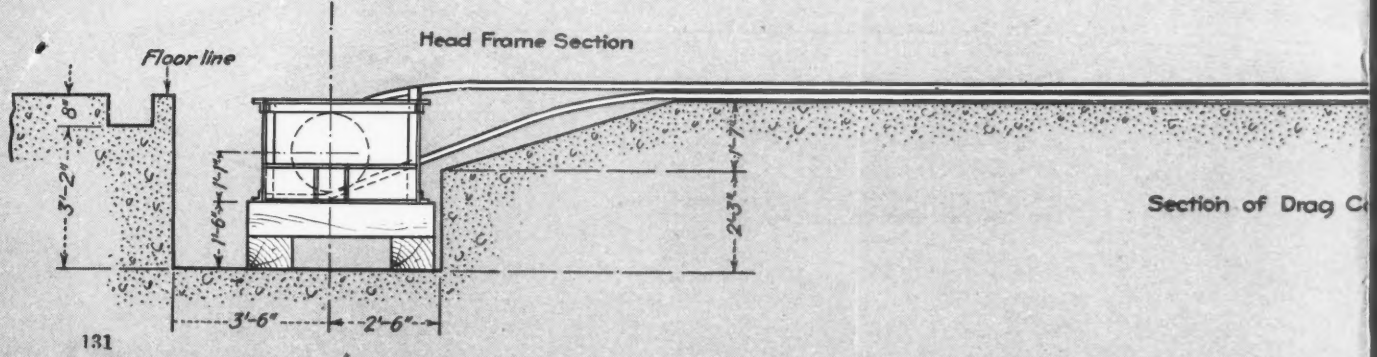
Schematic Diagram of Bell Aircraft Wing Production Lines and Detail Sketch of Installations

Note: Diagrams shown herein are schematic and bear no resemblance to the actual plant layout. Assembly lines move to the left and the return line moves to the right at a speed synchronized to accommodate all empty carriages from the slower moving assembly lines.

Women workers are trained for specific operations at individual stations and never leave the stations to which they are assigned. Pits at head and tail of each line are covered flush with the floor. Tracks and drag chain supports offer a minimum of obstruction.







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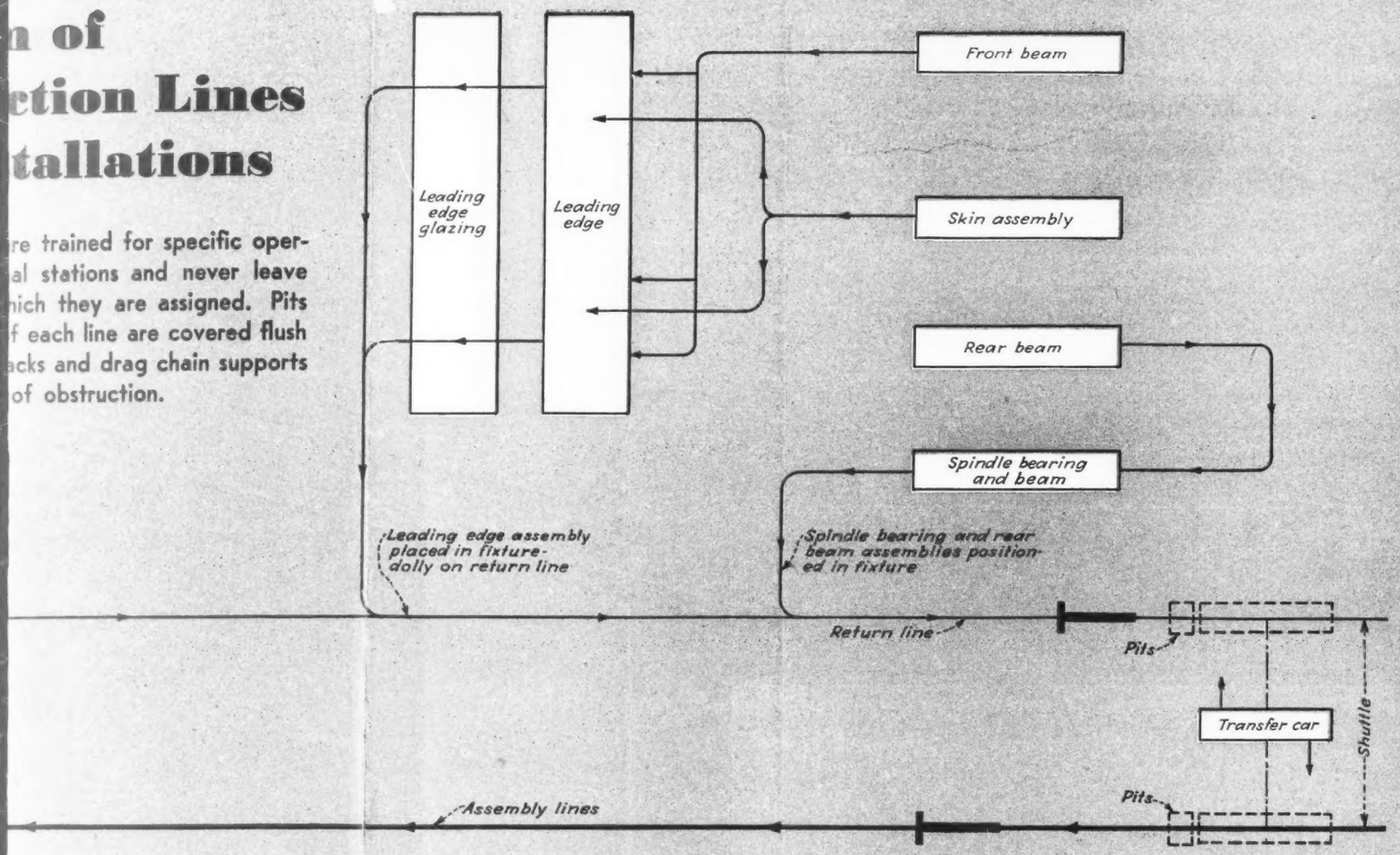
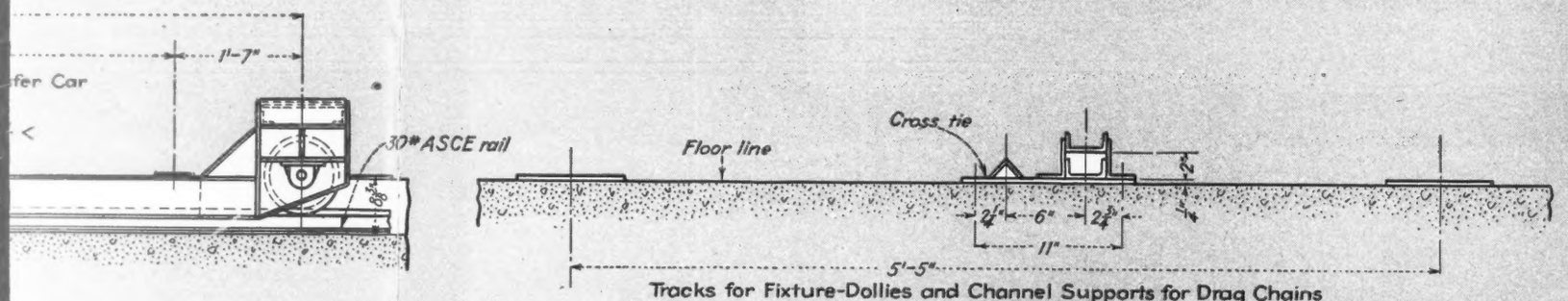
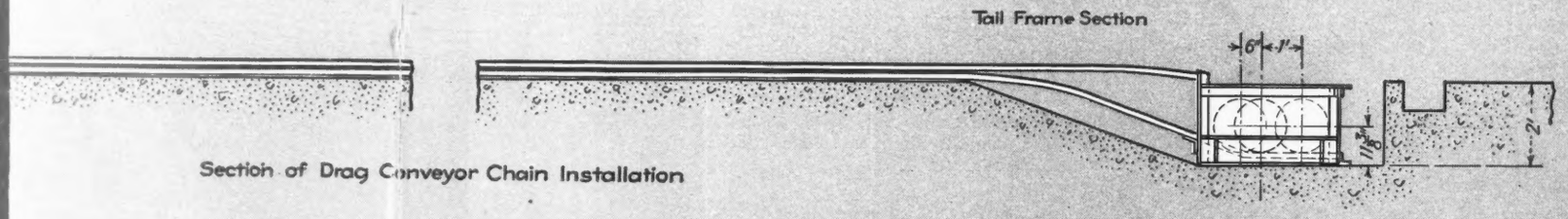
re trained for specific oper- al stations and never leave hich they are assigned. Pits f each line are covered flush acks and drag chain supports of obstruction.





Tracks for Fixture-Dollies and Channel Supports for Drag Chains



Section of Drag Conveyor Chain Installation

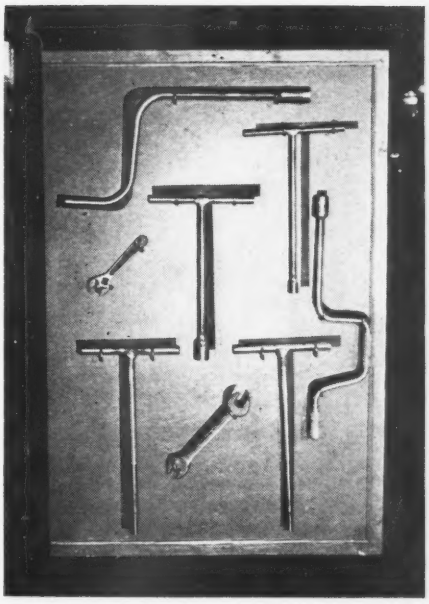
Fig. 9). The dummy door is disassembled and chard members are drilled.

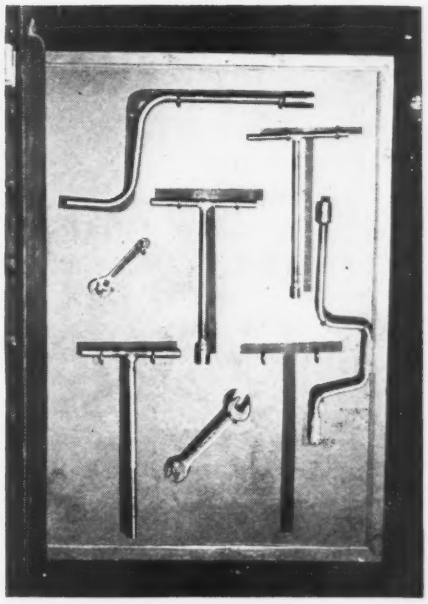
At Station 2, bulkheads are drilled, disassembled, cleaned of chips, then chromated and reassembled with Clecos. After bulkheads are riveted, gas-tight corners are assembled and fitted.

At Station 3, holes are drilled for the gas-tight corners. The parts are disassembled, chromated, then they are reassembled with set-up bolts and finally riveted.

The remaining bulkheads are assembled, drilled and riveted at Station 4. Plates and filler strips are assembled with Clecos around gun compartments. These are drilled, countersunk, and riveted (Fig. 9). Another dummy door is assembled to front and rear beams. Pilot and spring holes for Dzus fasteners are drilled. Dummy door is then disassembled and work inspected.

At Station 5, holes previously drilled are opened up, dimpled, and countersunk. Additional rivet holes are drilled through skin and spacers, then riveted. Splice plates and reinforcing plates and angles are assembled with Clecos and drilled.





4 **To avoid delays** incident to lost tools, these tool boards for wrenches needed to remove wings from fixtures are mounted at end of each line. Made conspicuous by its absence (right) a missing tool is promptly sought and returned to its place.

At Station 6, skins are fitted to bulkheads, drilled, disassembled, dimpled, then reassembled and riveted.

At Station 7, the gas tank cover assembly is fitted and drilled, disassembled, and countersunk. It is then reassembled at a later station after leakproof fuel cells are installed. Plates and spacers are assembled with Clecos and bolts, then drilled and countersunk. The oil cooler duct is also assembled at this station, drilled and disassembled. The bulkhead is countersunk for riveting the duct in place.

Station 8: Skin is reassembled and partially riveted.

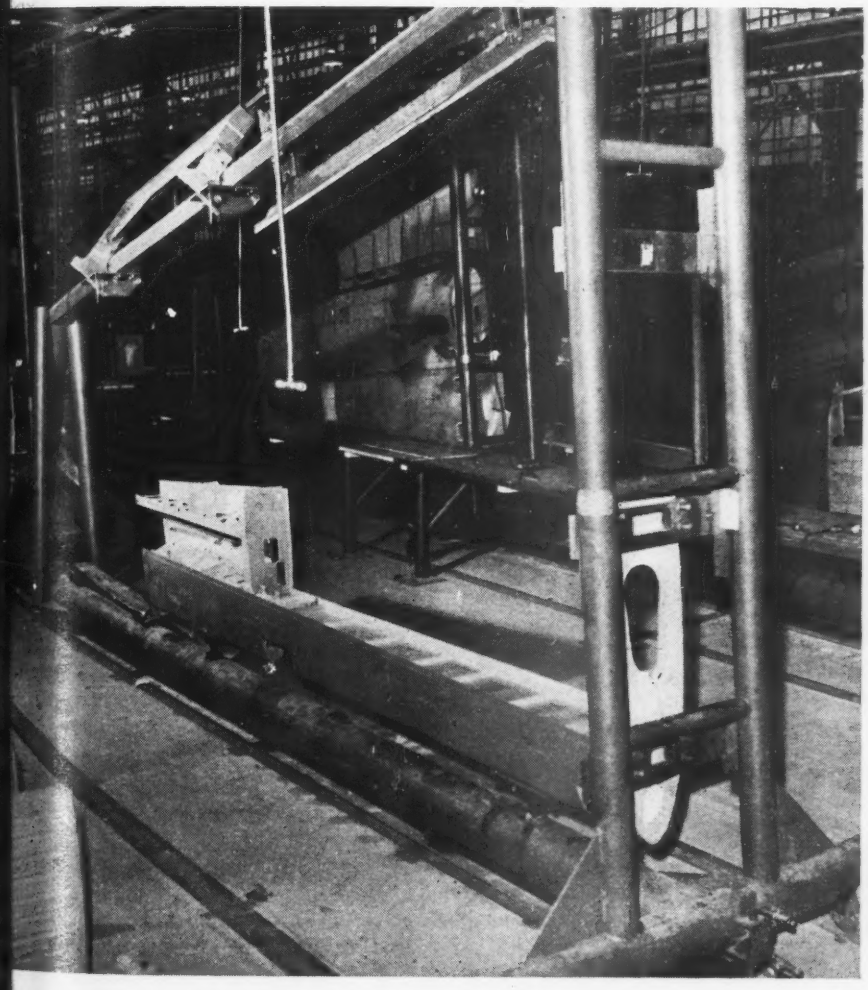
Station 9: Riveting of skin is completed, oil cooler ducts reassembled and riveted. The ammunition door is installed and the hinge drilled through beams. The hinge is disassembled and dimpled. The beam is countersunk for the hinge, the hinge reassembled and riveted. Door parts are reassembled. Anchor nut and screw assembly is drilled and riveted. Drain hole screw is installed.

Station 10: Channel nut assembly is drilled, countersunk, disassembled, cleaned, reassembled, and riveted. Dzus springs are installed and riveted. Camloc collars are installed.

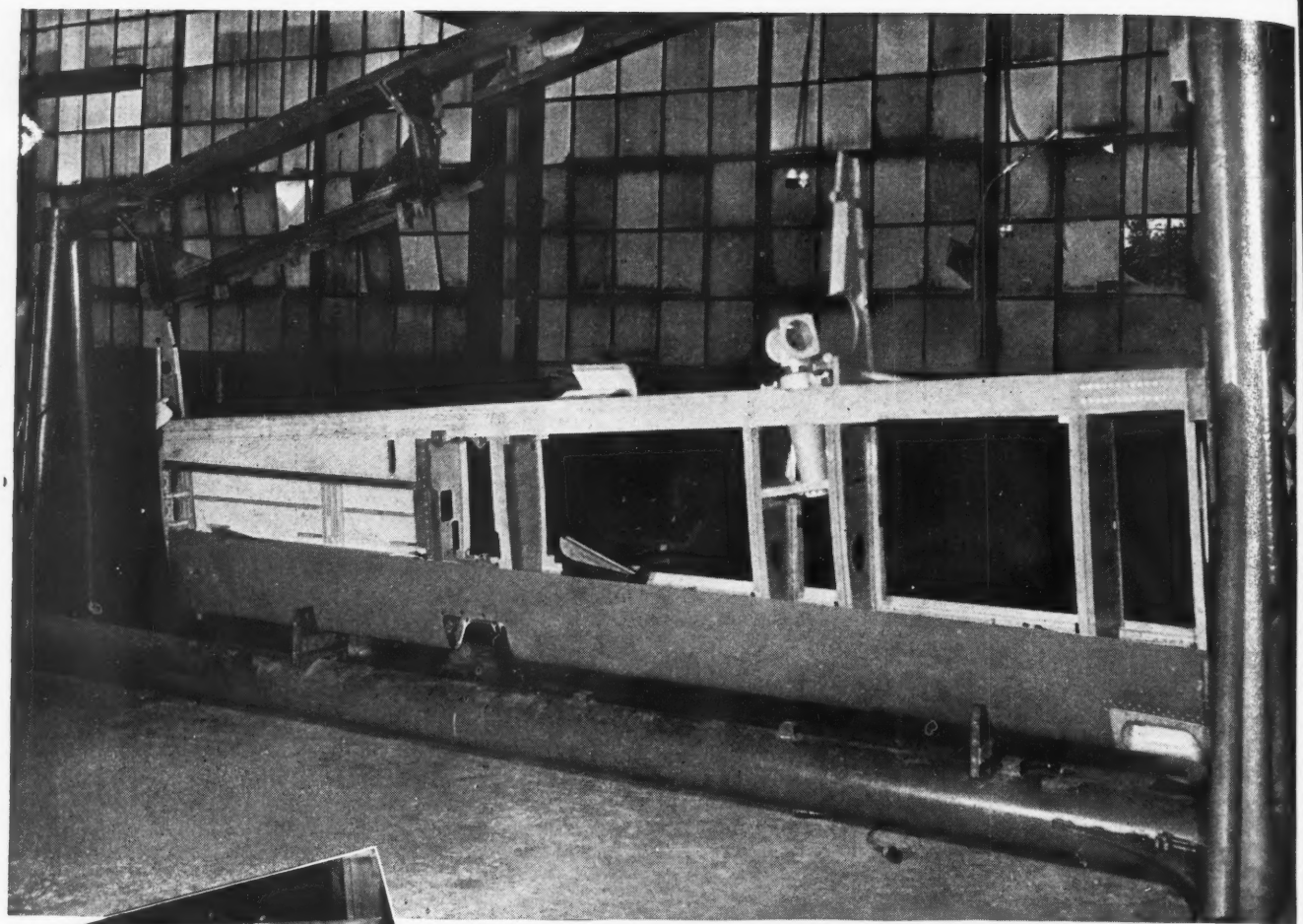
Station 11: Plates and fillers at gun compartments are riveted. Chord members at outboard end are riveted, then inspected. Fairleads are riveted to bulkheads and holes drilled for gas tank connection. Holes in web at liquidometer opening are countersunk, cleaned, and inspected.

Station 12: Gas bag area and gun compartment is cleaned out and inspected.

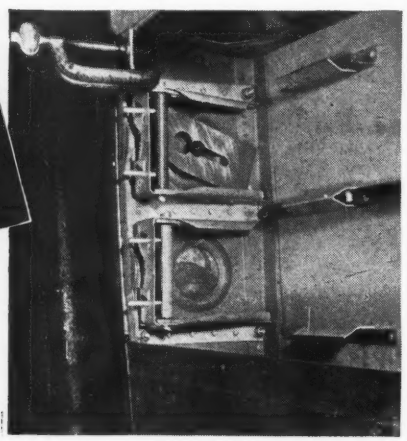
Station 13: Grommets are placed on bulkheads and plywood liners installed



First Step. Front beam-leading edge assembly bolted into fixture at intermediate point on dolly-return line. At end of line it is transferred to one of production lines and wing fabrication continues at Station 1.



6 Rear beam and spindle bearing assembly positioned in fixture. Attached to end plates with four bolts as shown in insert (left). At outer end, hinged fish-plate of fixture is swung up and attached to bulkhead with bolts and holding plates (insert below).



in gas compartment. Studs and gaskets are fastened to bag assembly and inspected. Chafing pad and bag assembly is installed and inspected. Flapper valve assembly is installed with clamps.

Station 14: Vent tube assembly, clamps, grommets, elbows, screws, nuts, and other tube assemblies, are installed and inspected.

Station 15: Cover assembly, ring assembly, strainer, gasket, fuel strap, and access door are assembled and installed. This is the cover assembly previously mentioned.

Station 16: Wheel well and trailing edge assemblies are installed and a dummy flap lined up in fixture. Additional bulkheads are installed.

Station 17: Bulkheads are drilled and riveted. A Cleco assembly is made of frieze skin, trailing edge, and spacer.

Station 18: Rivet holes are drilled in skin, hinges, and frieze skin. The skin is then disassembled. The small parts are dimpled on a general dimpler and the structure dimpled with a portable dimpler.

Station 19: Skin and stringer assembly and access door are assembled with Clecos, drilled, and disassembled.

Station 20: A bolt assembly is made of the drive unit and bracket assembly. Aileron control cables are hooked up and pulleys installed.

Station 21: Holes are drilled for the wing jack pad, then assembled and riveted. Skin is bolted to aileron brackets. Strainer holes in the tube assembly are plugged and testing apparatus mounted. Air pressure is built up to 2½ lb. and a check made for leaks. After inspection all tube outlets are covered with Selo caps.

Station 22: Drill pilot holes for Camloc collars for landing gear access door and assemble with Oleco fasteners. Assemble Camloc collars for door. Assemble top skin in fixture.

Station 23: Skin assembly is riveted.

Station 24: Rivet frieze skin on wing assembly. Riveting of fish plate is finished and holes drilled for brackets. Holes in skin are countersunk, then brackets are assembled.

Station 25: Miscellaneous drilling and riveting operations. Gun cable assemblies are installed. Tubes and hoses are installed in wing.

Station 26: Install vacuum and heater tubes. Drill bolt holes in bulkhead and hand rout skin flush with bulkhead.

Station 27: Boot and dust cover

assembly is installed and wing tip bolted to wing panel.

Station 28: Fasten inboard end of gun charging cables and cut to length. Solder clevis to cable. Install dummy gun and fit boot. Ammunition chute assemblies are then installed.

Station 29: Gun controls are hooked up, operation of gun control checked, and gun is hand charged with dummy ammunition. Chute and machine gun are removed and chute reinstalled. Grommets and control cables are installed.

Station 30: Gun wiring is hooked up with flexible conduit and cable clamps. Block switches and limit switches are hooked up. Liquidometer is hooked up with plug and cable clamps. Identification light line is next installed and connected.

Station 31: Recognition and running light wires installed and connected. A flap assembly is lined up and attached to the wing with hinge pins. The flap is lined up and throw adjusted with turnbuckle. Aileron assembly is installed.

Station 32: Trim tab cable is riveted to control chain. Cover assembly and inspection doors are fitted and installed.

Station 33: Strut and wheel assembly is installed and stops set for landing gear positions. Control switch assembly is installed.

Station 34: Landing gear door assembly is installed.

Station 35: Actuating link is assembled to landing gear strut and checked for fit and action. All assemblies are checked and then cleaned up.

Station 36: All electrical installations and wiring are inspected and the panel is prepared for painting operation. Stations 37, 38, and 39 are concerned with final inspection, "clean-up" operations, and the like.

Station 40: Wing panel is removed from the fixture-dolly and transferred to a sling swung from the overhead monorail which carries wing to drilling machine.

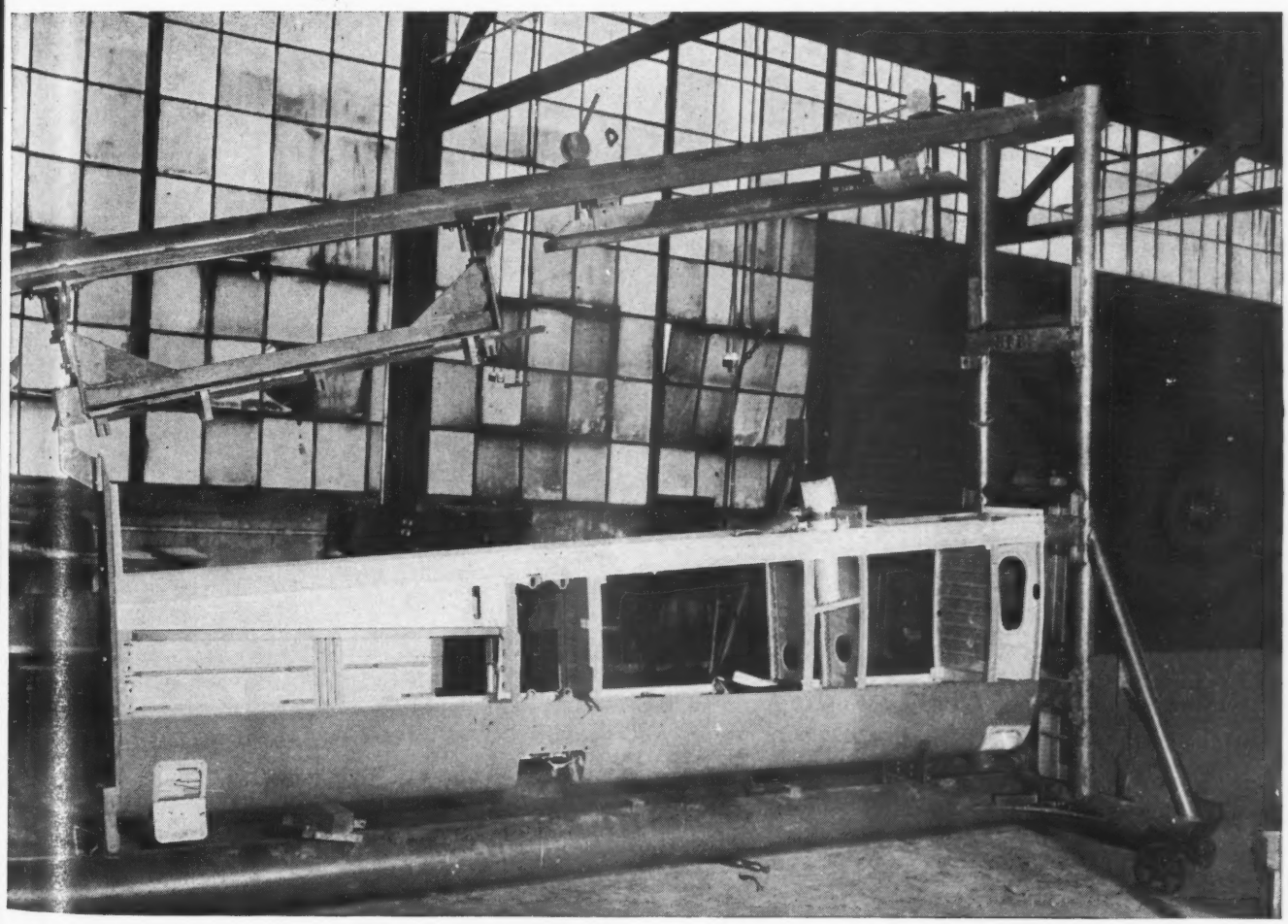
Station 41: A master fish plate drill fixture is bolted to inboard bulkhead of of wing and all holes are drilled simultaneously on a multiple drill. Bolt holes are reamed to size and drill fixture is removed.

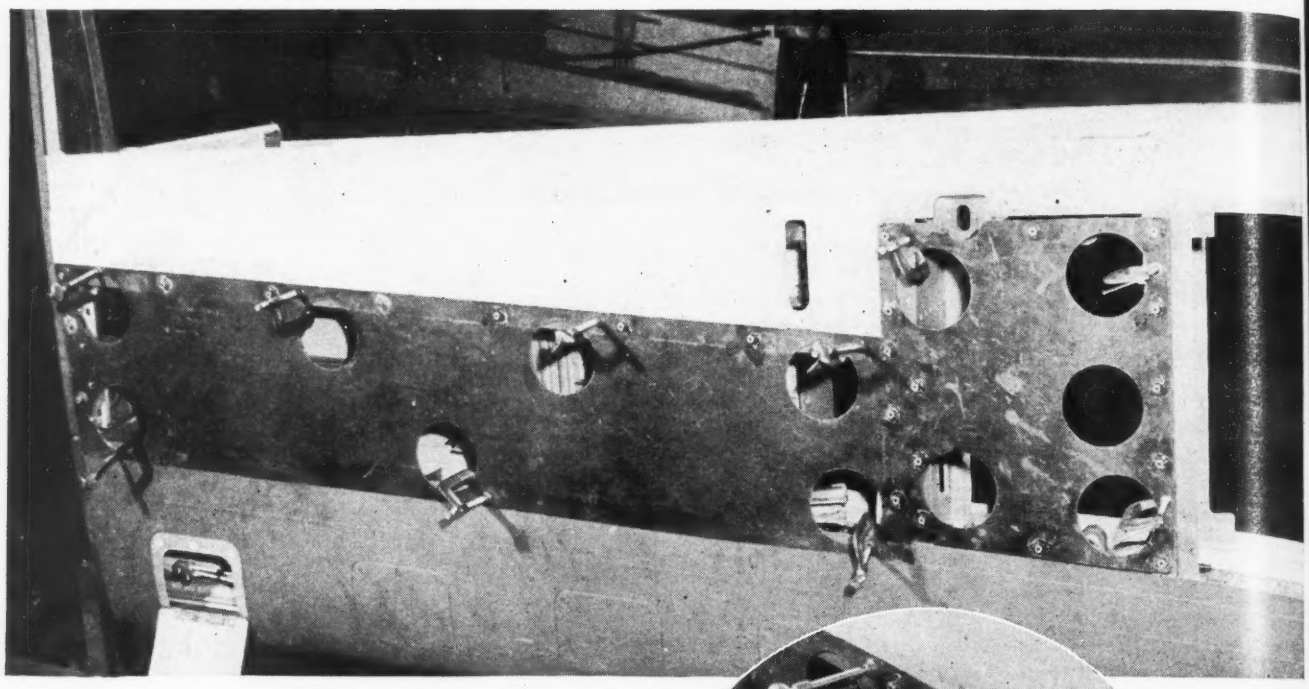
Station 42: Wing is then transferred from the monorail to an adjacent overhead conveyor which carries completed wing through paint booth. Wing completes a loop on conveyor and is then transferred to special wing trailers which carry completed wings to the final assembly plant.

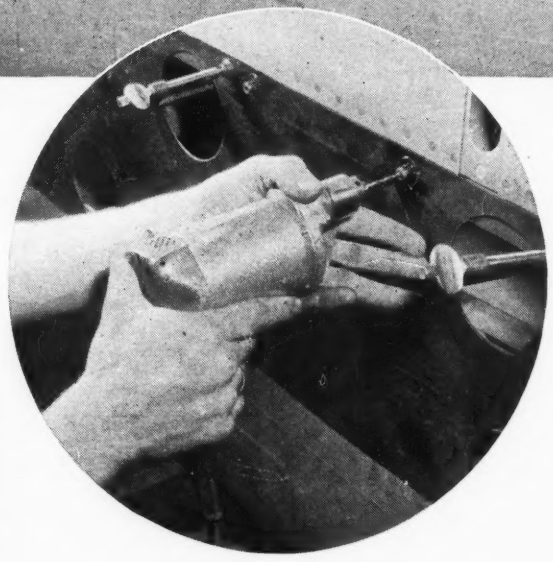
Thus are wings for Army *Airacobras* fabricated by women workers on a moving production line in record time. Bell Aircraft's wing department incorporates many proven tools and methods previously employed by the aircraft and automotive industries. But in its overall aspects, the wing fabrication line presents a brand new technique which marks a great stride forward in the achievement of high quantity production of complex modern fighter aircraft.

See following five pages for remainder of photo figures (No. 8 through No. 17) detailing Bell assembly methods.

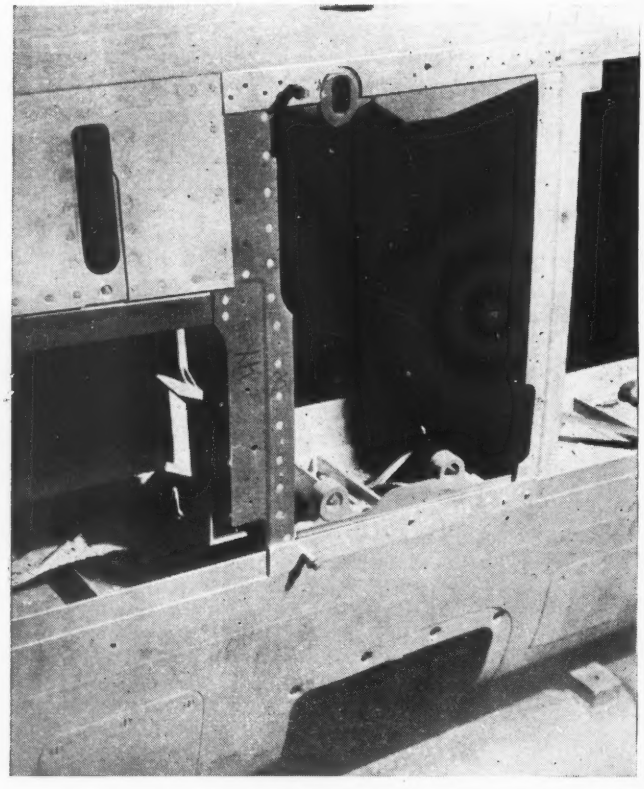
7 **Note how hinged fish-plate** is locked into position with aileron bracket locating fixture above. They are held together with a removable pin. Next, rest of bulkheads are assembled between front and rear beams.



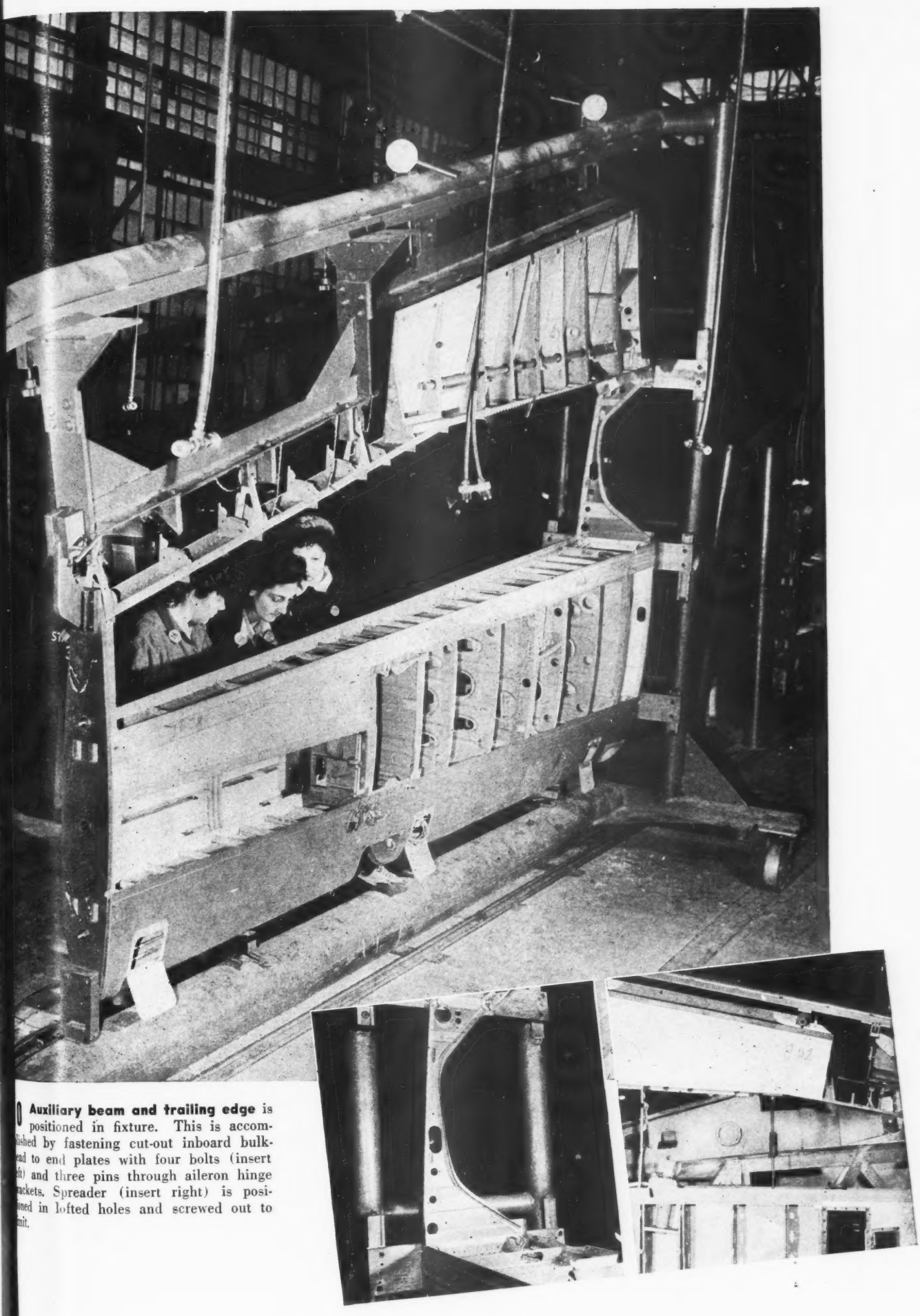




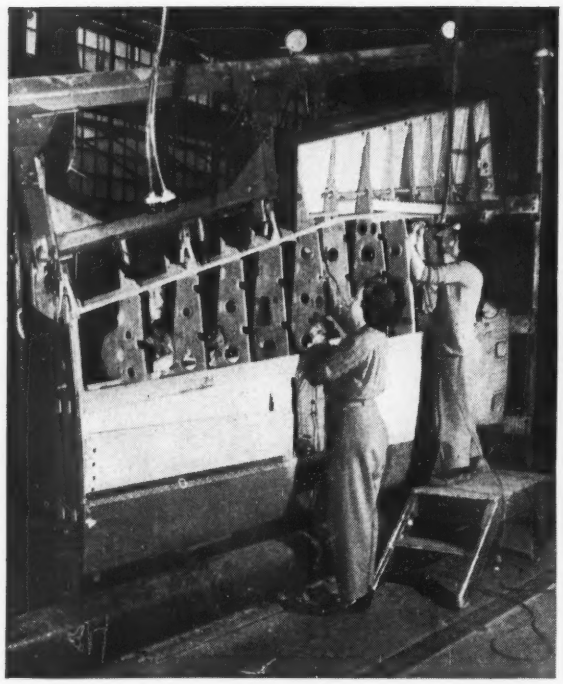
8 Dummy door is assembled to front and rear beams with clamps. Operator then drills pilot holes and spring holes for Dzus fasteners (right). Dummy door is then disassembled and work inspected.



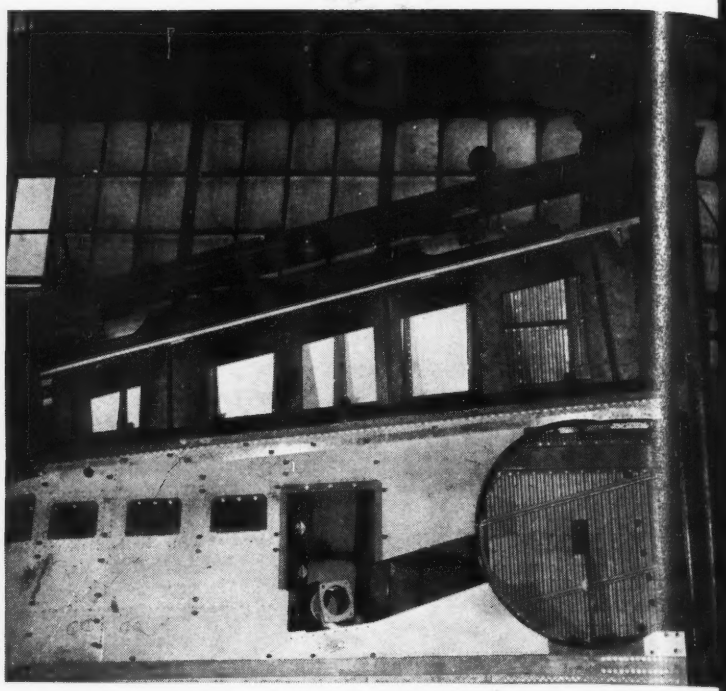
9 Plates and filler strips are positioned on both sides of wing, around gun compartment, and fastened with Clecos and bolts. They are then drilled, countersunk, and riveted.



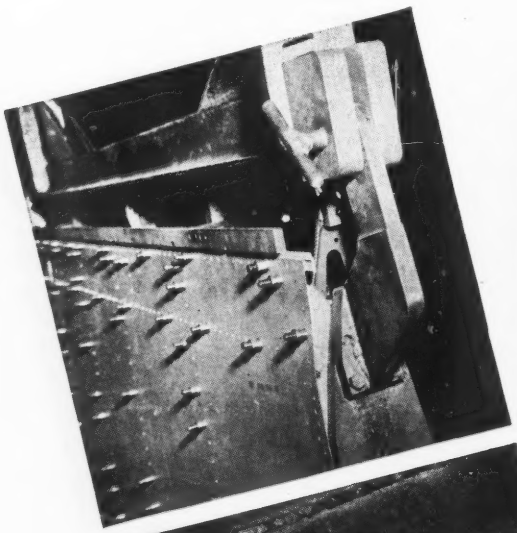
Auxiliary beam and trailing edge is positioned in fixture. This is accomplished by fastening cut-out inboard bulkhead to end plates with four bolts (insert left) and three pins through aileron hinge brackets. Spreader (insert right) is positioned in lofted holes and screwed out to limit.

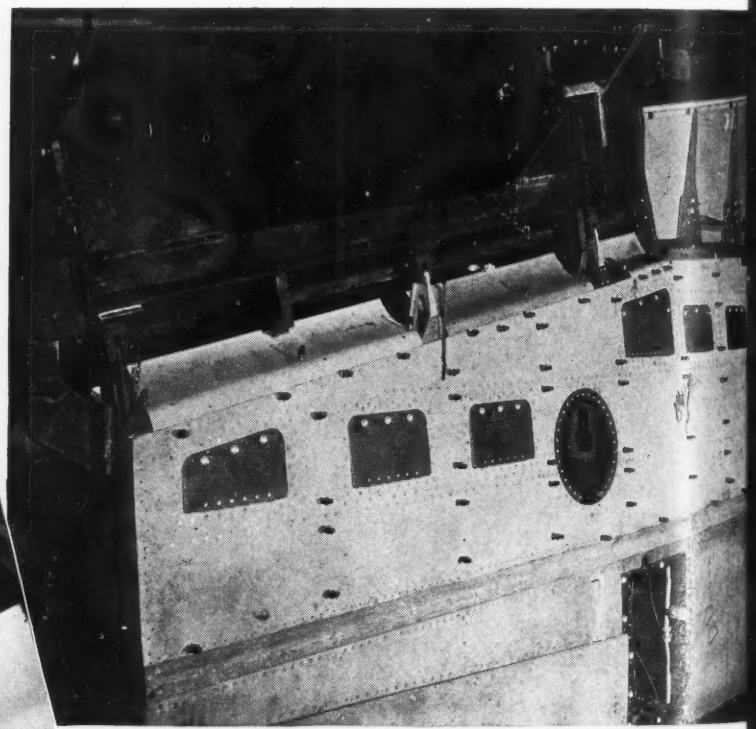


11 **Overhead locator lowered** to hold trailing edge extrusion in slot. Operators assemble all remaining bulkheads between rear beam and trailing edge auxiliary beam, then assemble channels and Cleco skin to bulkheads.

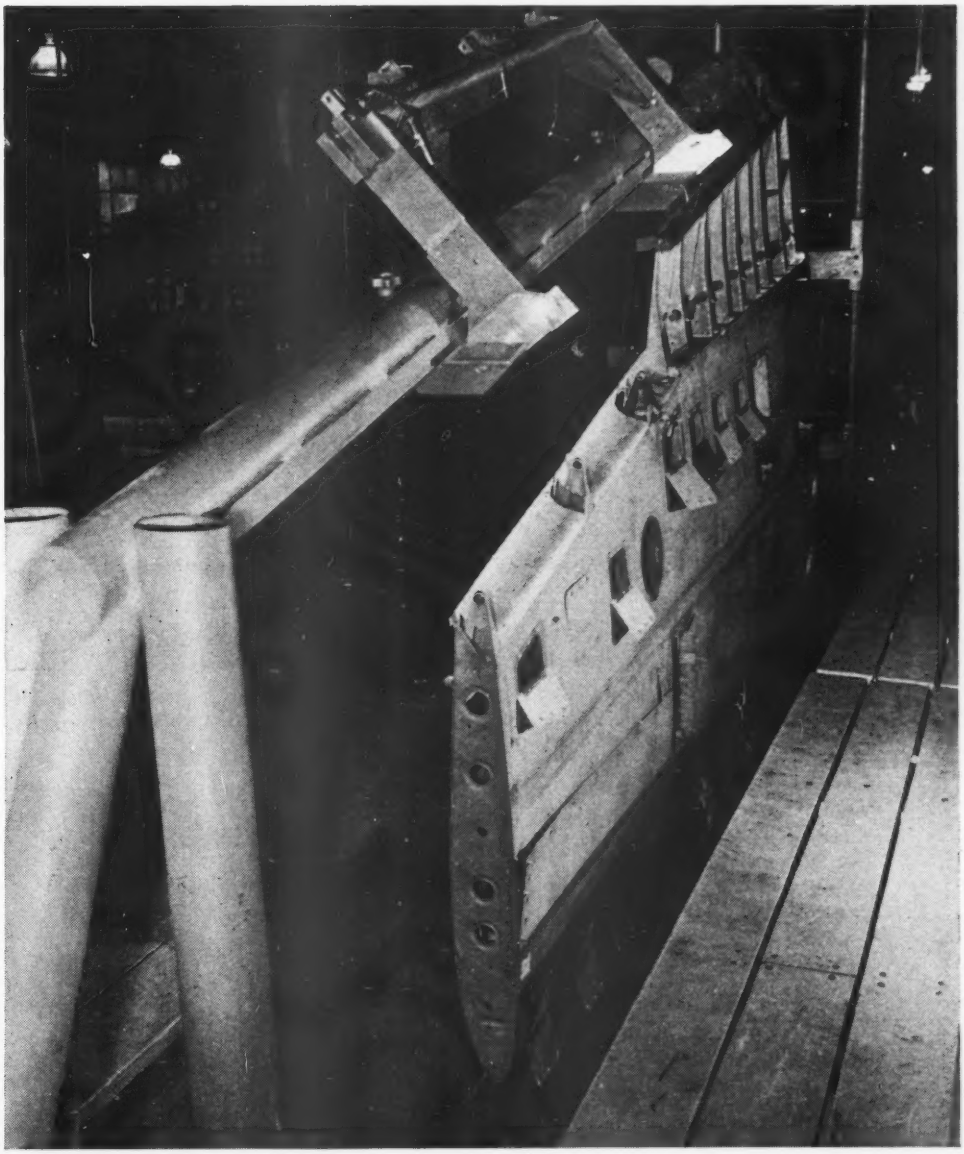


12 **Dummy flap is lined up with hinge** and wire inserted. Operator dri through hinge, skin and beam, Clecos hinge, then removes dummy fla Parts are dimpled on a general dimpler and structure with a portab dimpler.



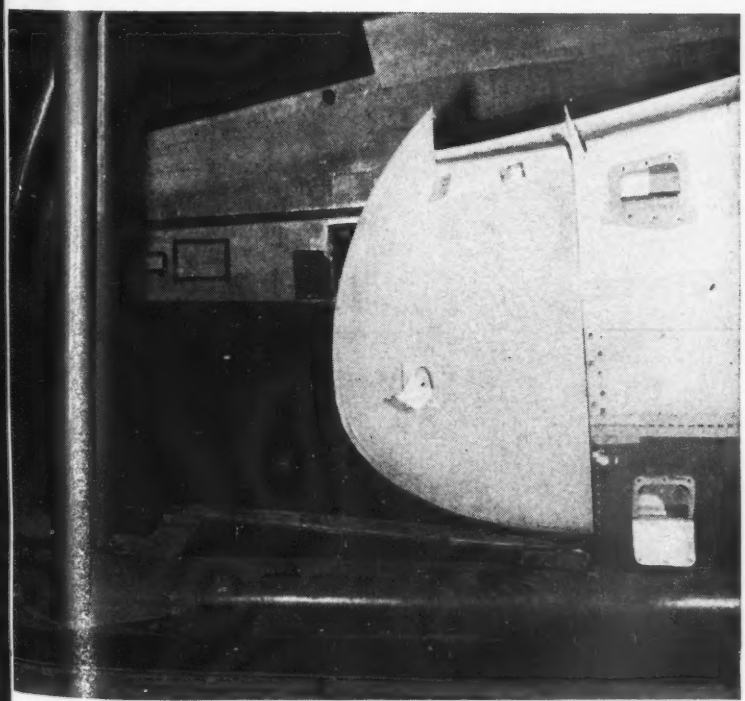


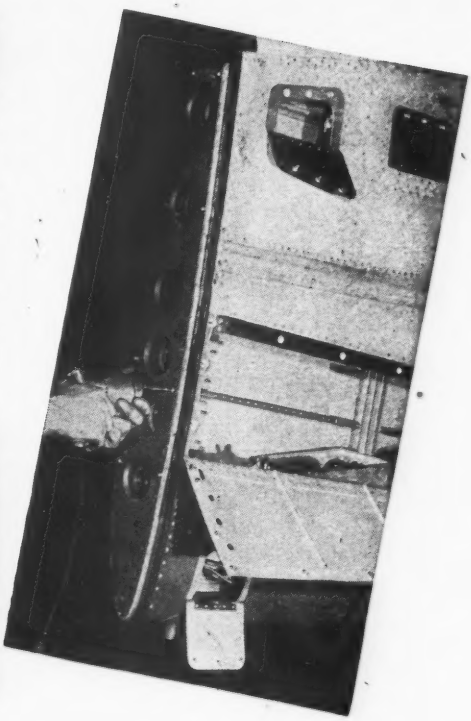
13 **Frieze skin is assembled to bulkheads** with Clecos. Operat drills through outer skin, frieze skin, and auxiliary beam, the Clecos. Jig attached to aileron locator bracket positions extrusio between frieze skin and top skin of wing (insert top). Operator Cleco and drills (insert bottom).

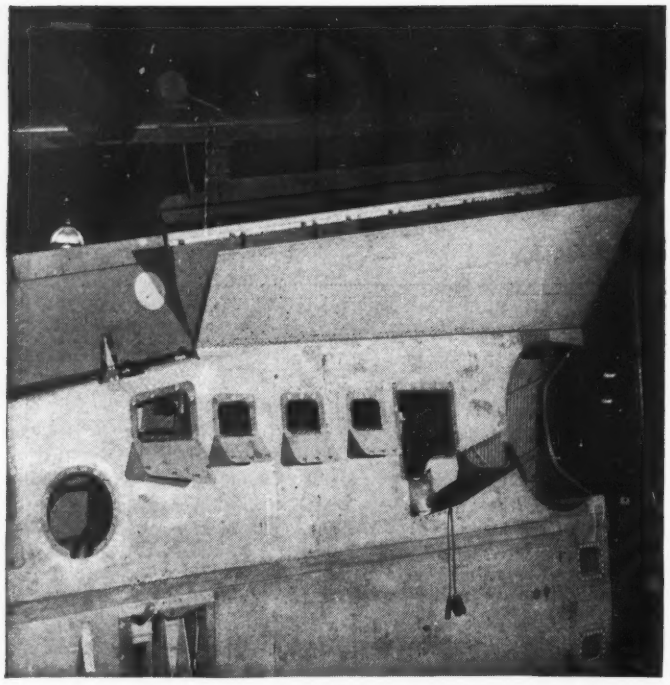


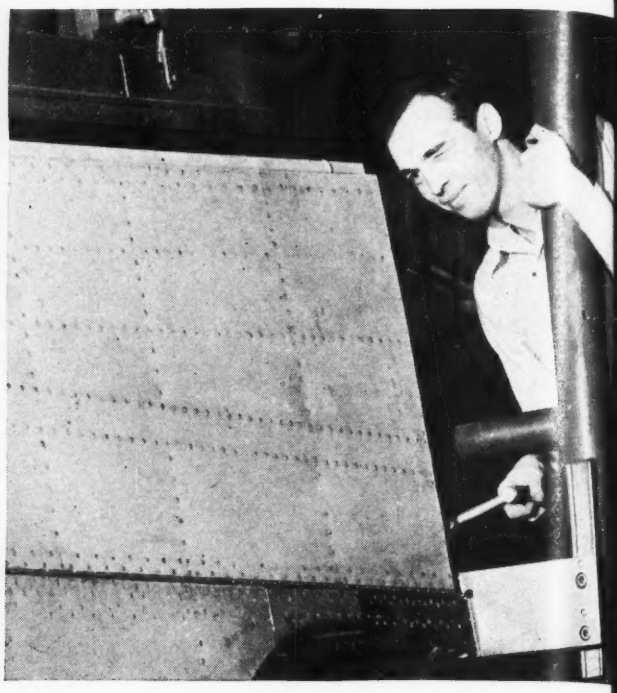
4 Pins are removed from aileron hinge brackets and xture swung free from wing. End h plate drops to main beam. rieze skin is riveted to frieze skin lkheads, then top skin, extrusion, d frieze skin are riveted together.

After hinged fish plate is dropped, drill jig is bolted bulkhead and bulkhead drilled letail lower right). Skin is uted flush with bulkhead, grom- ets and wires positioned, and ng tip bolted to wing panel.

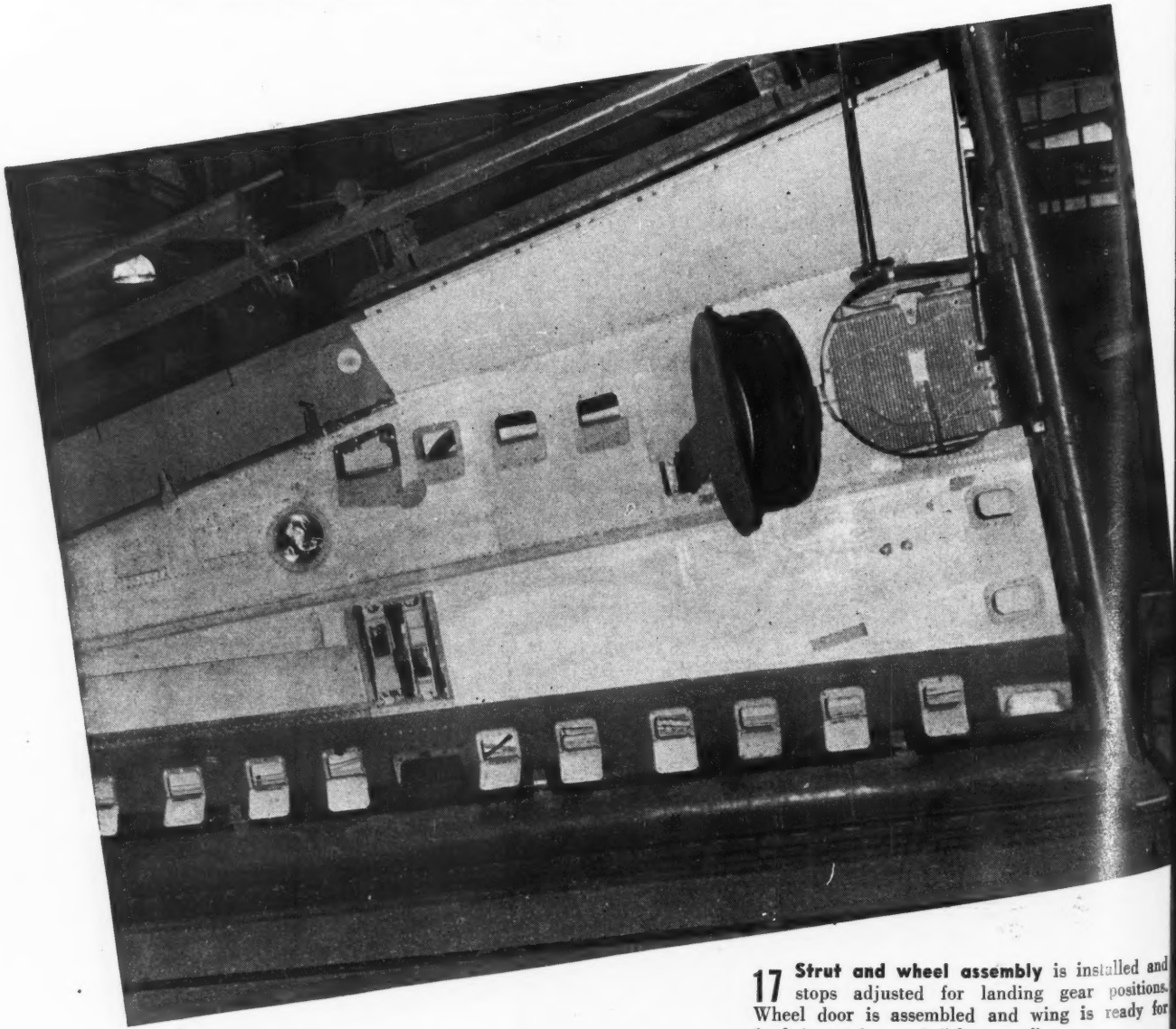








16 **Trailing edge locator fixture** is lifted and flap assembly completed. Aileron is installed and hooked up. Flap is then lined up and throw adjusted (right).



17 **Strut and wheel assembly** is installed and stops adjusted for landing gear positions. Wheel door is assembled and wing is ready for final inspection and "clean up."

The B.F. Goodrich Airplane of the month

REPUBLIC P-47

Don't be fooled by armchair strategists who talk about the superiority of other nations' fighter planes. Answer their comments with *the facts* about Republic Aviation's P-47. The "Thunderbolt," as it is appropriately known, has an effective ceiling of 40,000 feet, a super-charged 2,000 h.p. motor, unmatched speed and fire-power. No wonder the United Nations consider this Republic ship to be their ace-in-the-hole. Leading aircraft manufacturers are stepping up plane performance with the help of B. F. Goodrich Silvertown Tires, Expander Tube Brakes, De-Icers and Feed Shoes. This month, B. F. Goodrich nominates the Republic P-47 as Plane-of-the-Month.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B.F.GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*

Study of radial tire-growth as caused by centrifugal force!

IT HAS LONG BEEN KNOWN that tires tend to grow in radius as a result of centrifugal force, affecting the amount of clearance needed between a tire and its landing-gear strut. Today's faster-landing aircraft made this fact of greater importance to designers and builders of planes.

Mathematically, centrifugal force is known to vary directly with the square of the speed. Thus when speed is doubled—say from 20 to 40 mph—centrifugal force increases four times.

To measure the growth of a tire in inches, B. F. Goodrich engineers used a tire-testing machine, in which the road wheel, simulating movement of the ground beneath wheels during take-off and landing, was rotated at a speed of 140 mph. The tires measured were put on the swinging arm and brought into contact with the spinning road wheel.

A telescopic sight with a hair-line rule was focused at a fixed point on the tire's circumference so that any growth in the tire's radius could be accurately measured. The speed of the road wheel was varied from 140 mph down to 0 mph. Several sizes of tires were tested at these speeds.

Our engineers discovered that tire-growth varied only with the speed and *very little with the size of the tire tested.* In other words, at the same speed, a 30-inch and a 56-inch smooth contour tire grow about the same amount. The graph at the right makes this point clear.

Facts gained this way are of material help in designing landing gear as well as tires that will afford maximum safety for modern aircraft. The B.F.Goodrich, Co., Akron, Ohio.

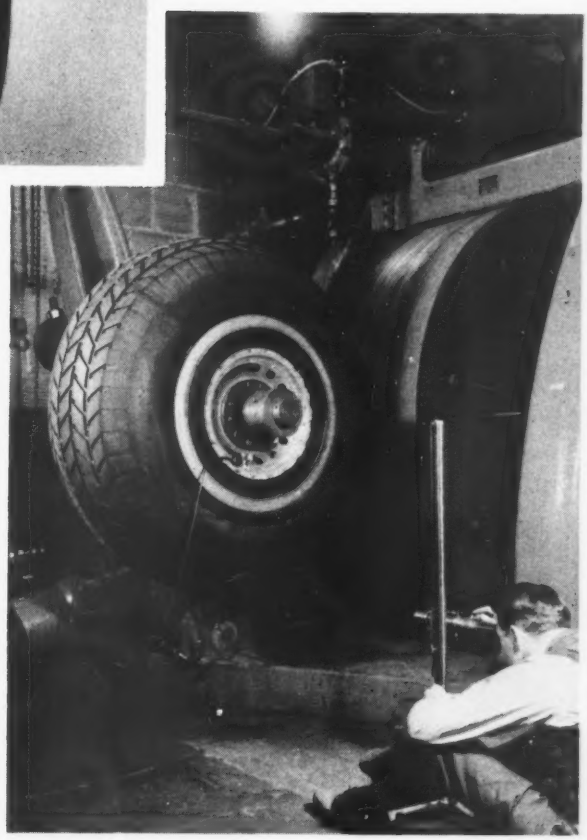
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

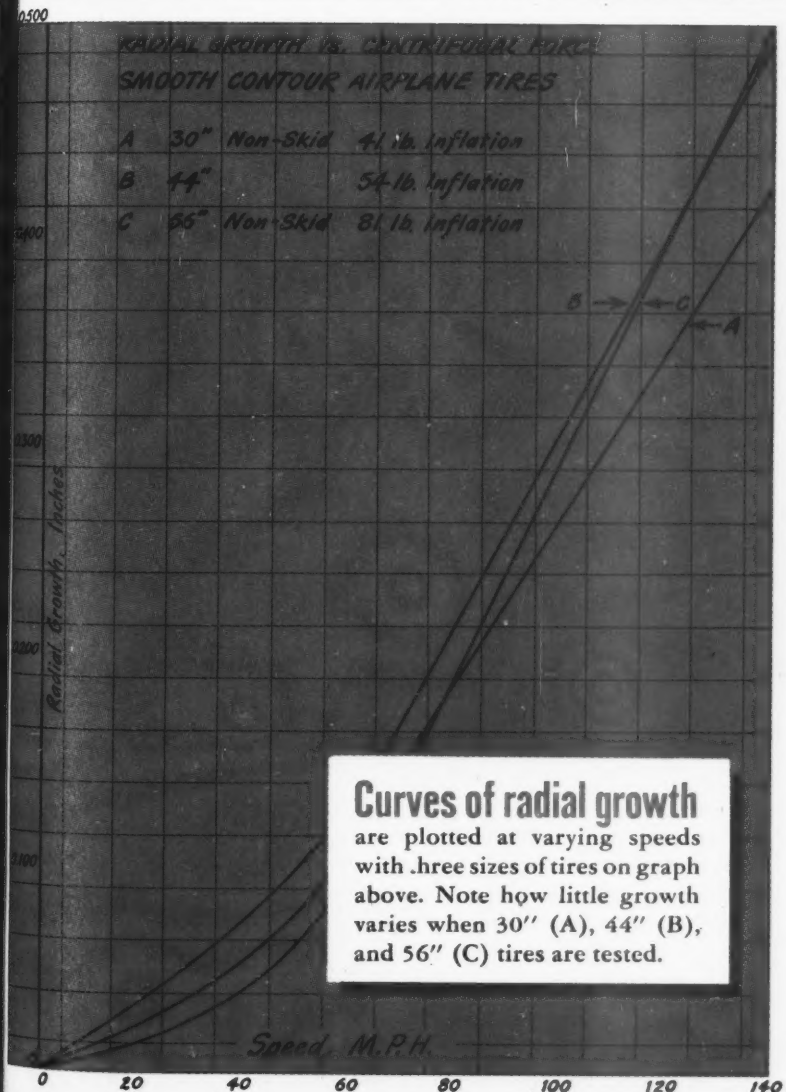
Test developed to measure radial growth

WHILE TIRES ARE IN MOTION!

Clearance of a tire in the offset and fork type of landing gear strut is reduced when tire radius grows due to centrifugal force. (Exaggeration of growth indicated by dotted line.) This has important bearing on landing gear design.

Sighting telescope on rotating tire to measure its radial growth. Hair-line rules on telescope lens permit accurate measurement in fractional inches. B. F. Goodrich Brake Tester was used to simulate action of tires during take-off and landing. Road wheel rotates at controllable speeds up to 150 miles per hour.





Curves of radial growth are plotted at varying speeds with .hree sizes of tires on graph above. Note how little growth varies when 30″ (A), 44″ (B), and 56″ (C) tires are tested.

In war or peace

B.F.Goodrich

FIRST IN RUBBER

FROM THE B.F.GOODRICH NOTEBOOK

DE-ICERS

DE-ICERS THAT DEFY TH ELEMENTS—B.F.Goodric has pioneered in the deve opment of rubber De-Icer which protect the leadin edges from ice. Most mil tary and commercial ai craft today are equippe with these De-Icers to pe mit flying in all sorts weather.

★

CRASH PADS—Anothe adaptation of B. F. Goodric molded sponge rubber illustrated here. The cush ioning effect of the cras pad protects the instrume panel. Again, the benefits extra light weight, i creased cushioning and e tra strength play an impo tant part in added safe and long life.

★

PROPELLER FEED SHO—Propellers, too, are pro tected from ice with th B. F. Goodrich device tha feeds the propeller blade with anti-freeze fluids.

★

RIVNUTS—This hollow threaded rivet can be i stalled and headed, or up set, while working entirel from one side. Develope for attaching De-Icers, it i adaptable to other aeronau tical uses.

★

FUEL CELLS—The illus tration shows one of man B. F. Goodrich Bullet Sea ing Fuel Cells for militar planes.

★

TIRES—For largest bomb ers or fastest pursuits, B. F Goodrich *Airplane* Silver town tires and tubes ar engineered for the job.

B. F. GOODRICH ★ AERONAUTICAL DIVISION ★ AKRON,

SIDE SLIPS

THE SILVER JUBILEE of Peace following World War II had been duly celebrated with great self-satisfaction by the peoples of the world.

But all was not sweetness and light. The same thing that happened after the war to end all wars" was happening again. Voices were being raised more and more frequently against the United Nations International Air Police which had been set up by the peace treaty. Not only was it a great expense, these Voices cried, but it kept the Axis people under a veritable heel. The money might better be loaned to the Axis for rehabilitation.

And the louder the Voices grew, the sweeter music they made to the ears of one man. Born—more or less legitimately—for the Nazi "state," neither his two winters' service on the Russian Front nor the sorry hide-saving spectacle put on by Hitler, Himmler, Goering, and Goebbels when things collapsed served to swerve him from the New Order ideology. For all the 25 years since the war he had worked to restore Nazism—with himself as the head of the state. Not that the United Nations intelligence service didn't know what was going on—it was still traditional for democratic people to let a man think what he wanted.

To some people then, it wasn't surprising when this man got himself in as head of the government. Nor was it very surprising when the one-time home of Nazism began to resume its old-time arrogance.

Suddenly, though, it all became very, very familiar. This man made a terrific speech: Those brutal, ruthless, war mongering Belgians (the few who hadn't been shot or starved to death) had to quit persecuting the poor downtrodden Germans or he'd step in and take over.

Next day the American Ambassador invited this man for an airplane ride, along with several other diplomats. The United Nations, he explained, were holding a small scale maneuver, and no doubt this man would enjoy attending.

So next day they took off. As they approached the French border the sky was literally darkened with huge airplanes bearing the markings of the United Nations International Air Police. "Just 2,500 of our medium bombers," said the American Ambassador, adding—in the lengthy verbiage of diplomacy—"if you don't shut up, the other half, plus the really big babies, will blast you and your big mouth off the face of the earth."

Meanwhile, as the bombers headed north, the English Ambassador eased into the seat next to this man just as the sky again darkened with the wings of southbound fighter-bombers, also bearing the UNIAP markings. "So sorry not to be able to show you some of the new stuff old man," said the Ambassador in effect, "'twould be bad poker, you know."

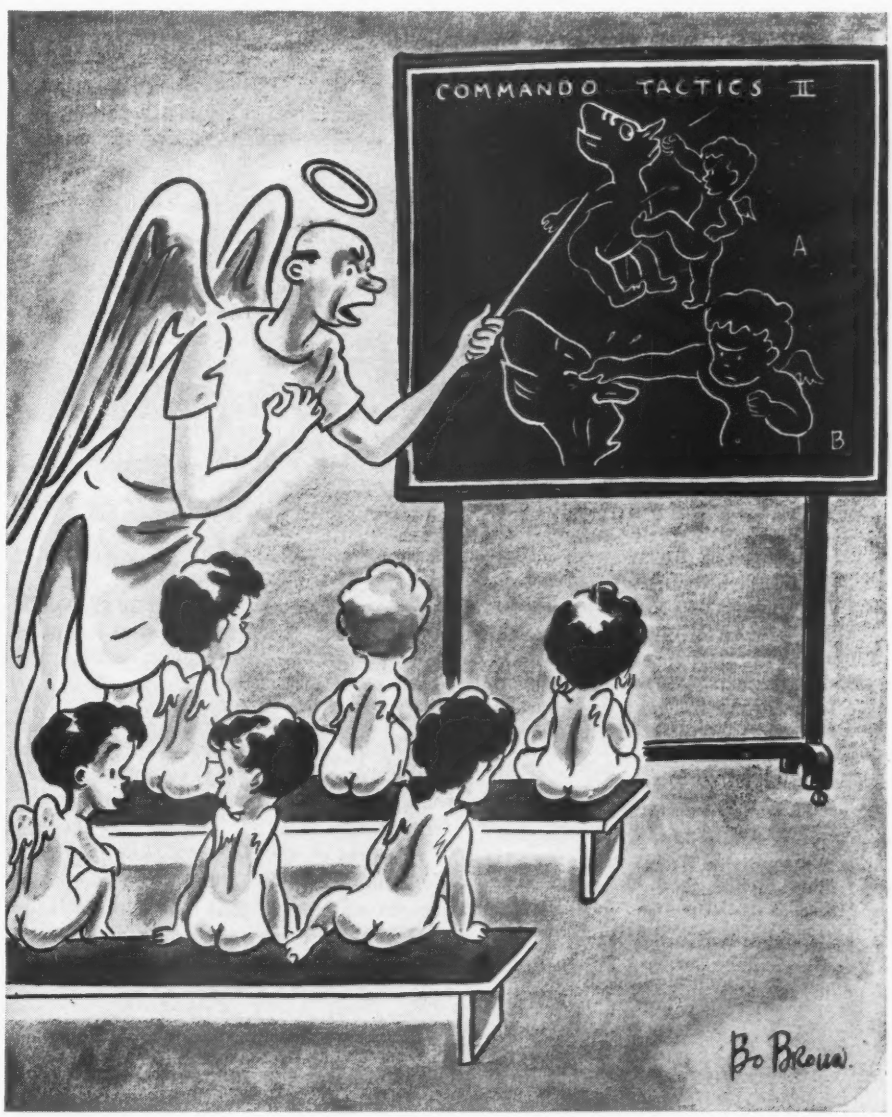
When the Czechoslovakian military attache slid into the seat next to this man and pointed to wing after wing of fighters, bombers, transports, and cargo planes, his eyes glittered and he said fervently, "Ah, if only I could give them the order, here and now!" The Soviet Ambassador was also succinct—but nonetheless diplomatic. "One thing about airplanes," he said, "you don't take prisoners."

As this man stepped from the plane at the end of the trip he muttered to himself—in effect—"nuts to this dictator business. I'm afraid I'll have to make an honest living."

Later, as the American and English Ambassadors stretched before a fireplace with their drinks, the American said dejectedly, "A war was won today without spilling a drop of blood, yet it probably means the end of my diplomatic career. Why? Because this man has helped start people complaining about the cost of the Air Police, and now the cost of sending them out today on their first good maneuver will give more ammunition for the abolitionists."

"So, you have them, too," replied the English Ambassador, "I thought our tight little isle contained all the people who think we can actually save money that way."

"No, there have always been that kind, and I'm afraid there always will be. We can only hope there will be sufficient people who can realize what happened today and who will insist on keeping the Air Police up to proper strength."



Maguire's teaching us to fight dirty against the gremlins.

The "inside story" on better cylinder barrel

● The "inside story" of why Tube Turns forges *better* cylinder barrels lies *inside the barrels themselves.* Here, in the exceptionally close grain structure gained through Tube Turns' forging methods, is the all-important reason for this added strength and quality.

Tube Turn cylinder barrels are produced in the world's largest forging machines—mammoth 9" upsetters weighing over 500,000 pounds—whose compact design and great rigidity make it possible to forge airplane engine cylinders *with the extreme accuracy, grain quality and speed required.*

There is another "inside story" worth remembering—and that is, what happens when Tube Turns cylinder barrels are *inside an engine.*

That is where their added hardness and extra close grain structure prove their worth . . . in withstanding terrific friction and heat, in lengthening the life of engines, in keeping 'em *flying* instead of grounded with cylinder trouble. We are proud of our part in helping leading manufacturers to produce airplane engines that will *out-perform and outlast* anything the Axis has to offer!

ALUMINUM PISTONS, TO

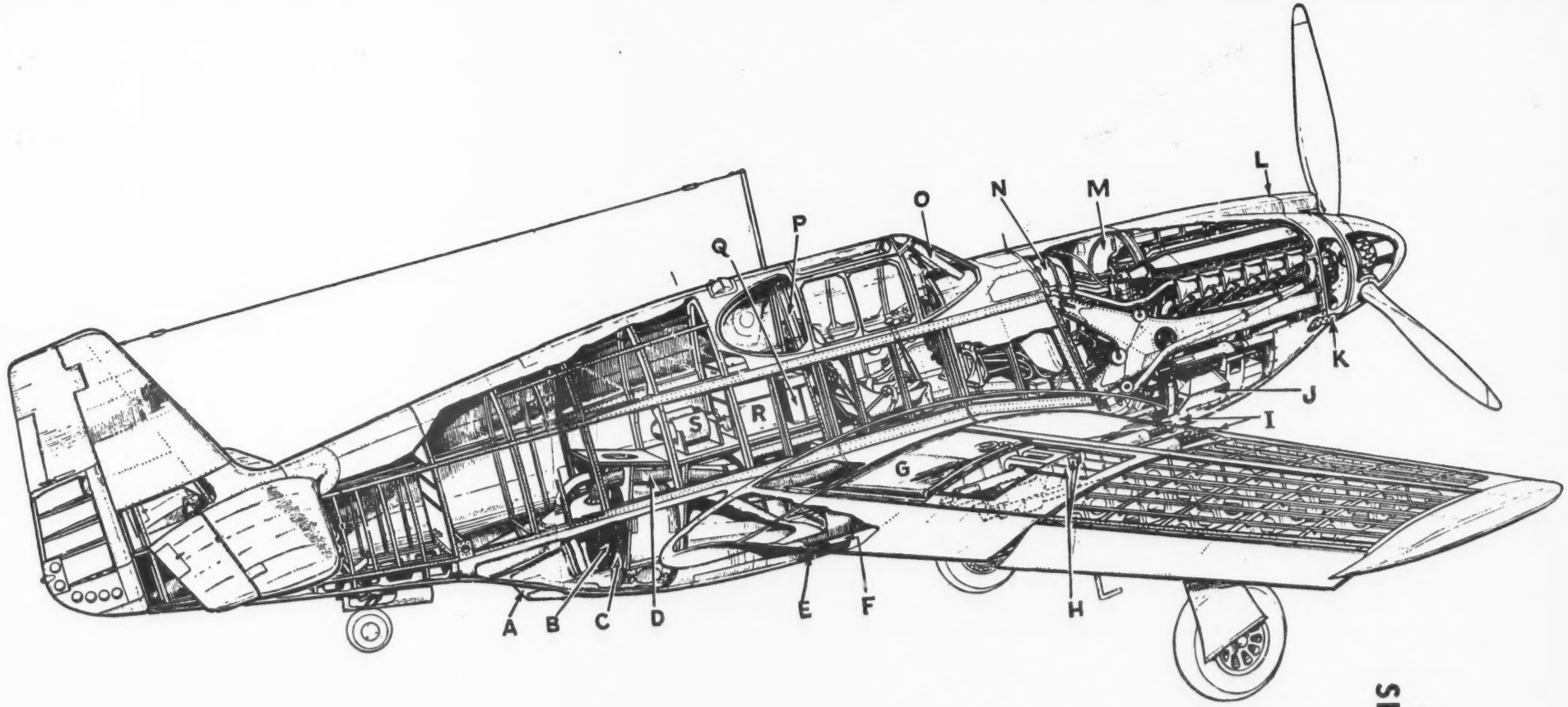
Another Tube Tur achievement is the for ing of *aluminum pisto* —by use of one-pie dies in a Maxipre This method permi accurate control of metal flow, which turn vastly improves the grain structu and durability of the piston.

Tube Turns' forging activities are confin solely to large and difficult types of forgin On products such as those cited here, offer specialized experience and every mode facilities. Because of this strict specializ tion, we are not concerned with dr forging, general job forging operations ordinary small forging work.

TUBE TURNS

Specialists in producing difficul precision forgings from variou steels, aluminum, and other metal

Tube Turns (Inc.) Louisville, K



SKETCH BOOK OF DESIGN DETAIL

North American P-51 *Mustang* has been called one of most aerodynamically advanced aircraft in service today. In this cut-away illustration, redrawn from *Flight*, many of interesting structural details are revealed. Reading counter-clockwise, they include: Rear shutter of air scroop "A," containing oil and engine radiators "B" and "C," respectively. Warm air is taken to cockpit through pipe "D." Front shutter of scoop is at "E," air entering at "F." "G" is 70 gal. self-sealing gasoline tank, and three ammunition containers are at "H" for machine guns "I." Another ammunition container is at "J" for machine gun "K." Carburetor air intake is at "L," air being taken to down-draft carburetor through duct "M," just in front of 10 gal. oil tank "N." Bullet-proof glass "O" is part of standard armor. Over-turn structure is at "P." Ship's battery is depicted at "Q," radio units are seen at "R," and the oxygen containers of the craft are at "S."

Helping to "BRING 'EM BACK ALIVE"

Nothing in this war is more heartening than the large number of pilots and plane crews who come back alive from missions of extreme hazard.

Case after case has occurred where planes suffered terrific punishment, yet the pilots managed to bring them home. It is a tribute to the splendid skill of our pilots and the remarkable quality of our planes.

Vickers Hydromotive Controls are an important factor in the exceptional quality of American planes. These high pressure oil hydraulic controls stand a lot of knocking about... they're insensitive to shock and vibration. Yet they are instantly and easily responsive ...dependable, accurate, easily adjusted.

They have been found superior in a wide variety of control jobs.

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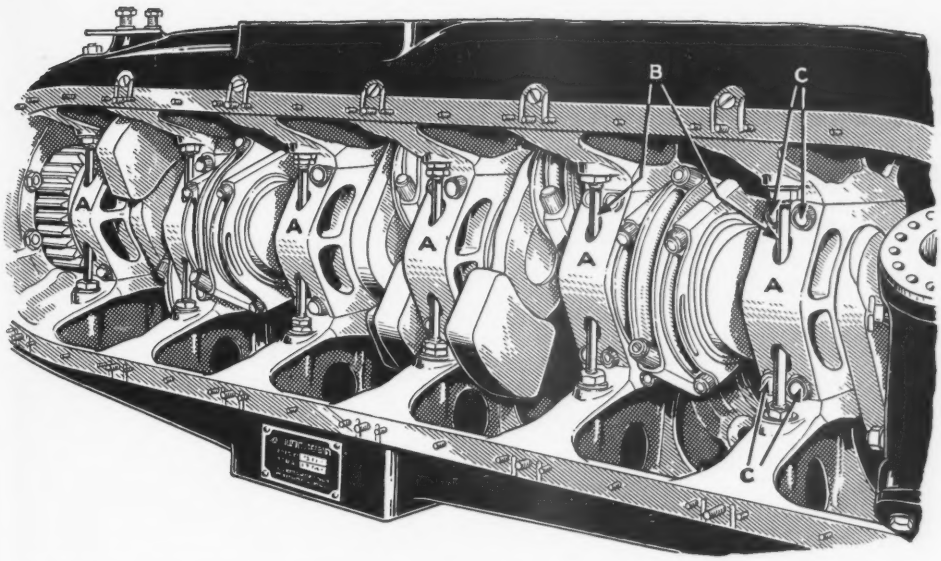
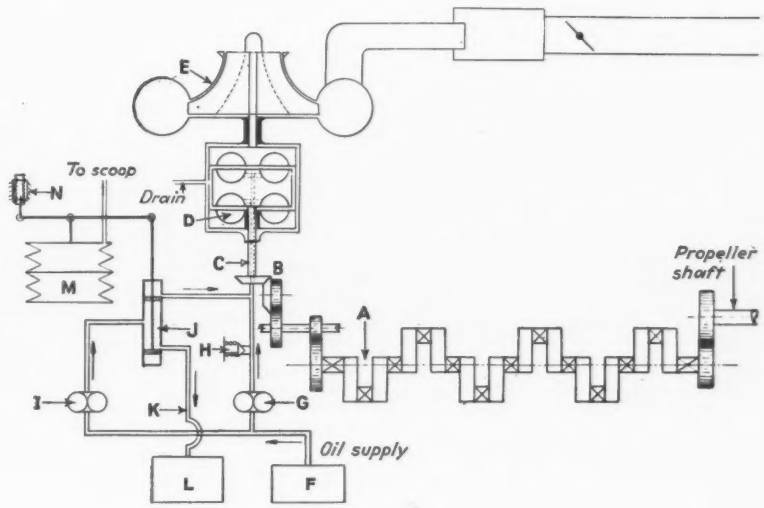
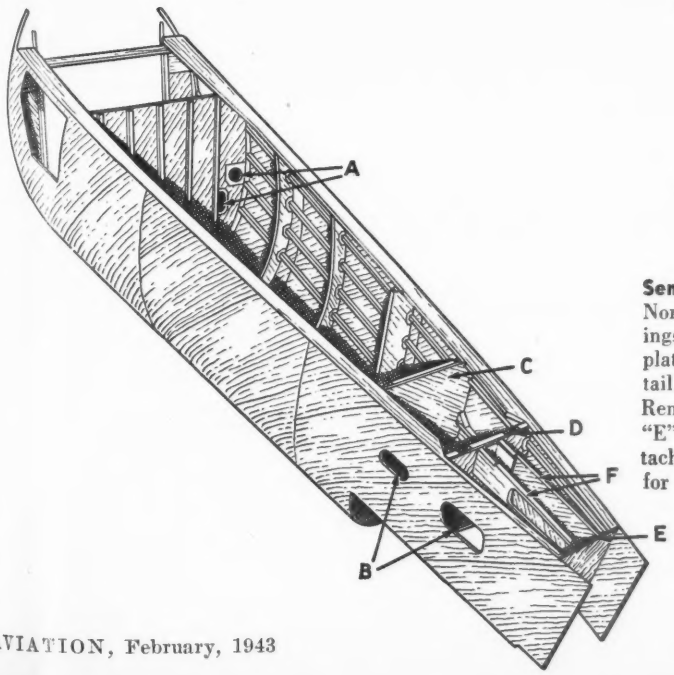


Main bearing supports of Mercedes-Benz DB-601A engine, as revealed in a study made by Raymond W. Young of Wright Aeronautical Corp., are carried (see "A") in heavily webbed sections with wide flanges. A through tie-bolt "B," with extremely highly polished finish and secured by nuts inside and outside crankcase, passes through each main bearing and stiffens entire section, preventing localized scuffing. Four stepped and mirror-finished studs 'C" secure each bearing cap. As in case of connecting rod nuts, a finely serrated head is used with addition of a spherical radius seating washer.

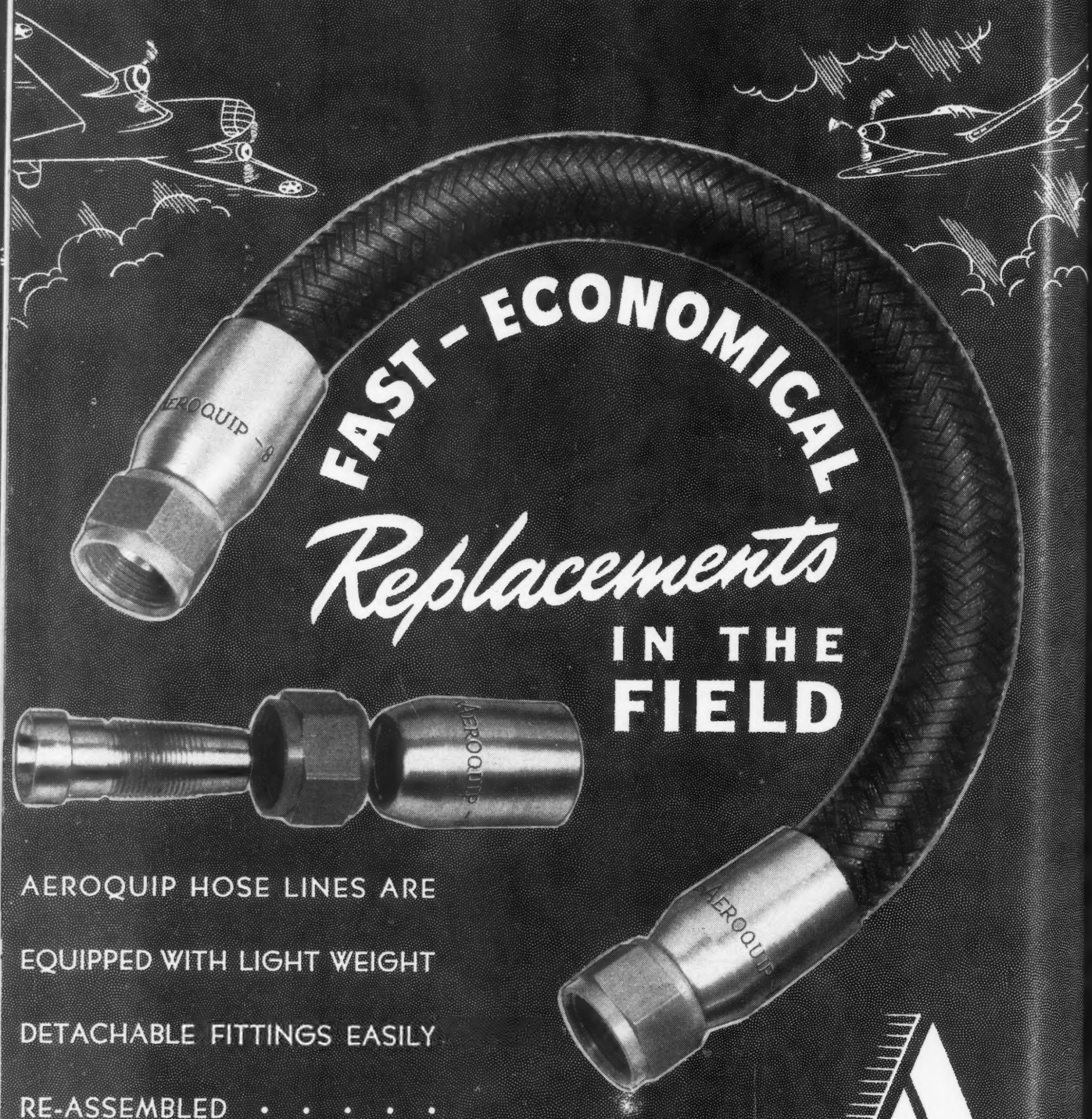
Supercharger fluid drive of Mercedes-Benz 601A engine takes its power direct from crankshaft "A" through bevel gears "B," hollow drive shaft "C," and driving rotor "D," which is splined to shaft. Impeller "E" is of 10¼ in. dia. smoothly machined all over and finished by anodizing process. "F" is oil filter, fluid going through primary engine driven pressure pump "G" with a safety valve at "H." A secondary engine-driven pressure pump "I" supplies oil under regulation from balanced by-pass valve "J," with line "K" for return to oil sump "L." Sealed syphon "M," with adjustment "N," controls piston in balanced valve "J," and is responsive in action to changes in atmospheric density through air induction scoop.





Semi-monocoque construction of plywood aft-section of North American trainer fuselage is illustrated at left. Openings "A" are for cables and those at "B" are for inspection plates. Bulkhead 'C" absorbs part of load imparted from tail wheel, front part of assembly being attached at bottom. Remainder of load is distributed through bulkheads "D" and "E" through longitudinal members "F," which comprise attachment for top of oleo. (Also see AVIATION's Sketch Book for Aug., Sept., Nov., and Dec., 1942).

AEROQUIP HOSE LINES



FAST - ECONOMICAL *Replacements* IN THE FIELD

AEROQUIP HOSE LINES ARE EQUIPPED WITH LIGHT WEIGHT DETACHABLE FITTINGS EASILY RE-ASSEMBLED . . . . .

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EASTERN REPRESENTATIVE:
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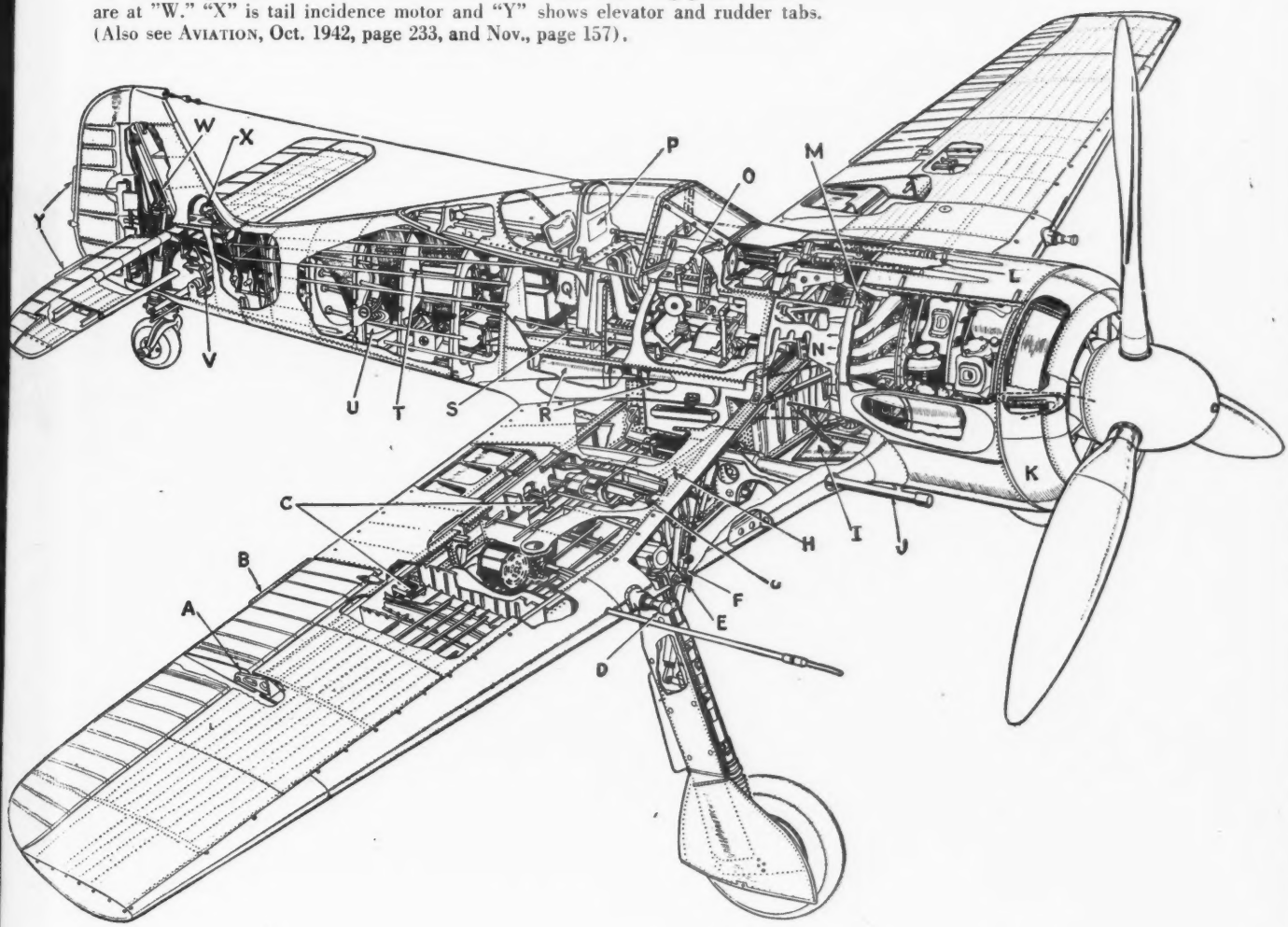
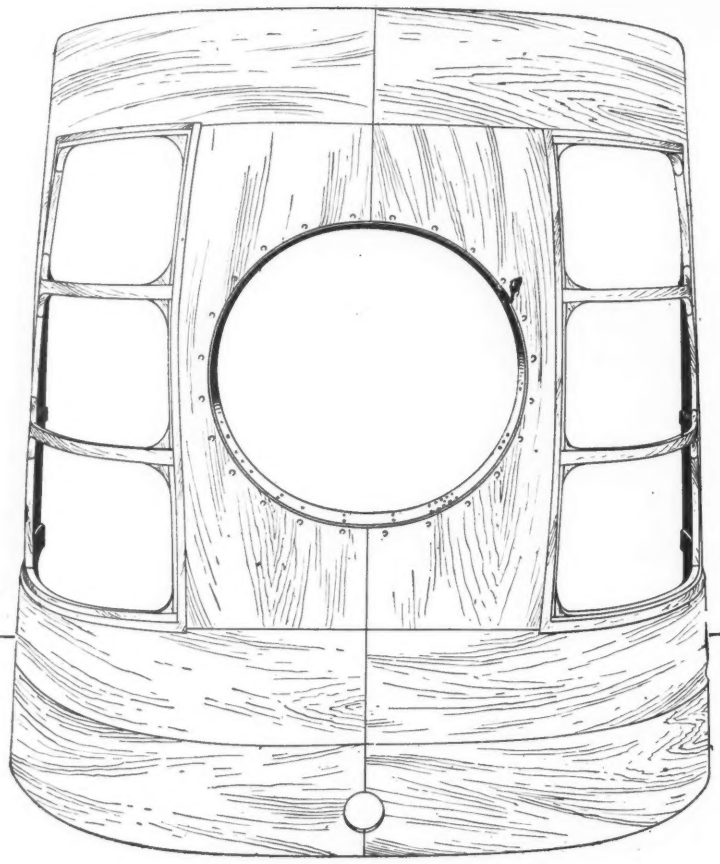
AEROQUIP CORPORATION
JACKSON, MICHIGAN, U. S. A.

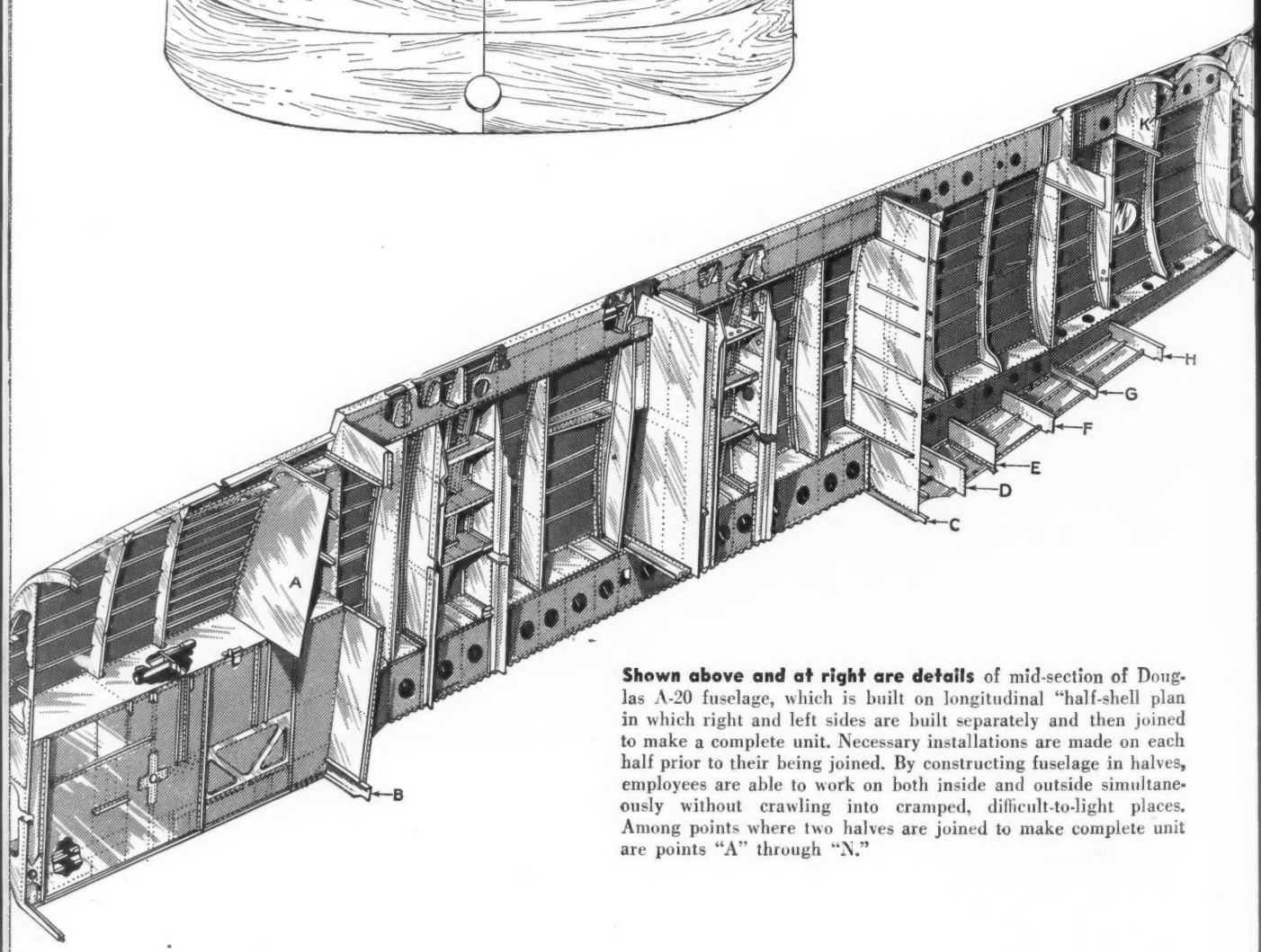
AEROQUIP SELF-SEALING COUPLINGS

Structural details of Focke-Wulf 190A3 revealed in this cut-away illustration, re-drawn from *The Aeroplane*, include following: Aileron hinge bracket and open-end shroud are at "A," with aileron tab—adjustable only on ground—at "B" and aileron control at "C." "D" is one of two 20-mm. cannon, firing outside propeller arc. Landing gear radius rod break hinge is at "E," operating tail wheel retracting cable "F." Landing gear retracting power is delivered by electric motor "G," with position being checked by indicator "H." Hinged cover "I" drops to admit wheels upon retraction. "J" is one of two 20-mm. cannon firing through propeller arc. "K" is armor-plated cowling enclosing oil cooler. Two 7.9 machine guns are at "L," firing through propeller. Oil filter is at "M" and engine exhaust outlets at "N." Throttle is at "O," while "P" is 14-mm. armor plate to protect pilot from rear. Adjusting mechanism for pilot's seat is at "Q." Fuel tanks of 64 and 51 gal. are shown at "R" and plane's battery at "S." Tail wheel retracting cable is at "T" and compass at "U." Tail wheel lock is at "V" and shock leg guide and lock are at "W." "X" is tail incidence motor and "Y" shows elevator and rudder tabs. (Also see AVIATION, Oct. 1942, page 233, and Nov., page 157).

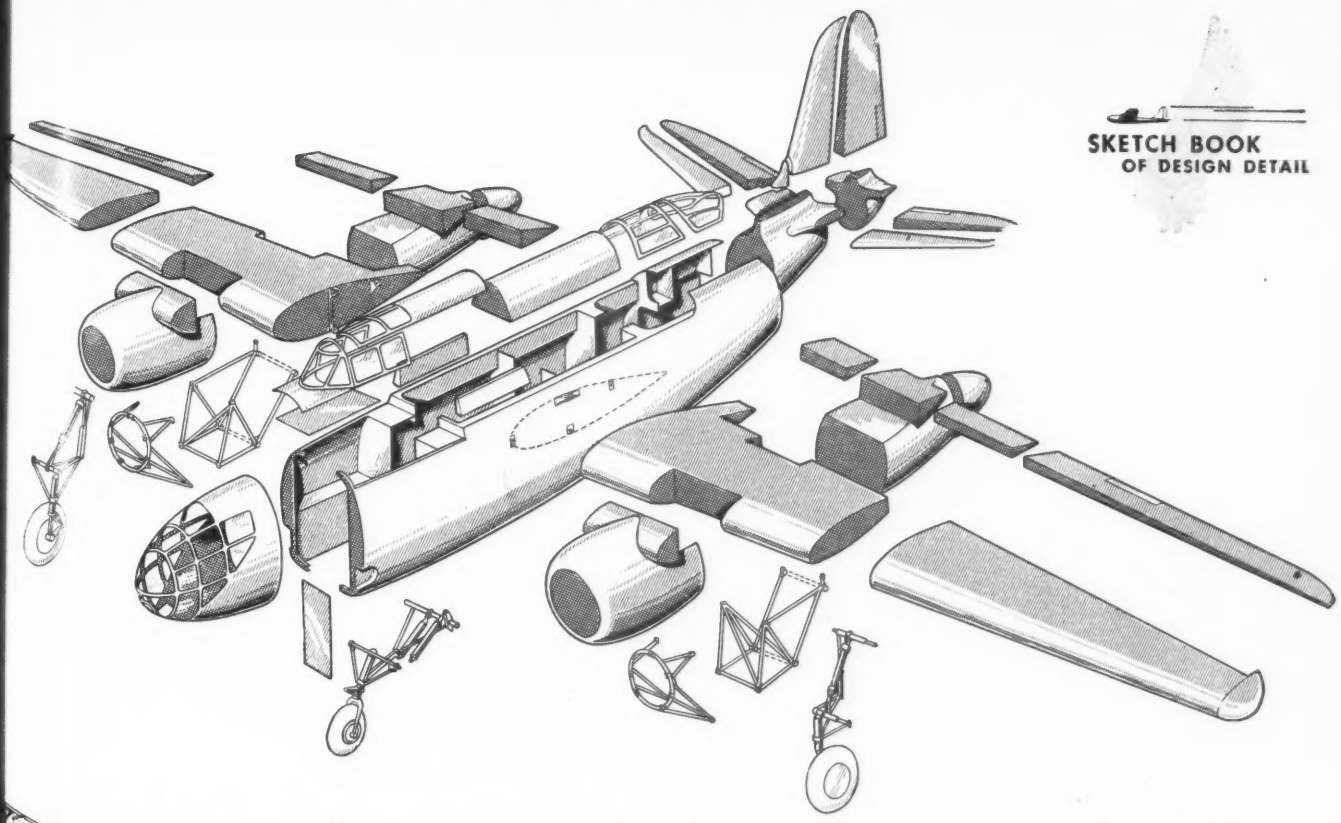


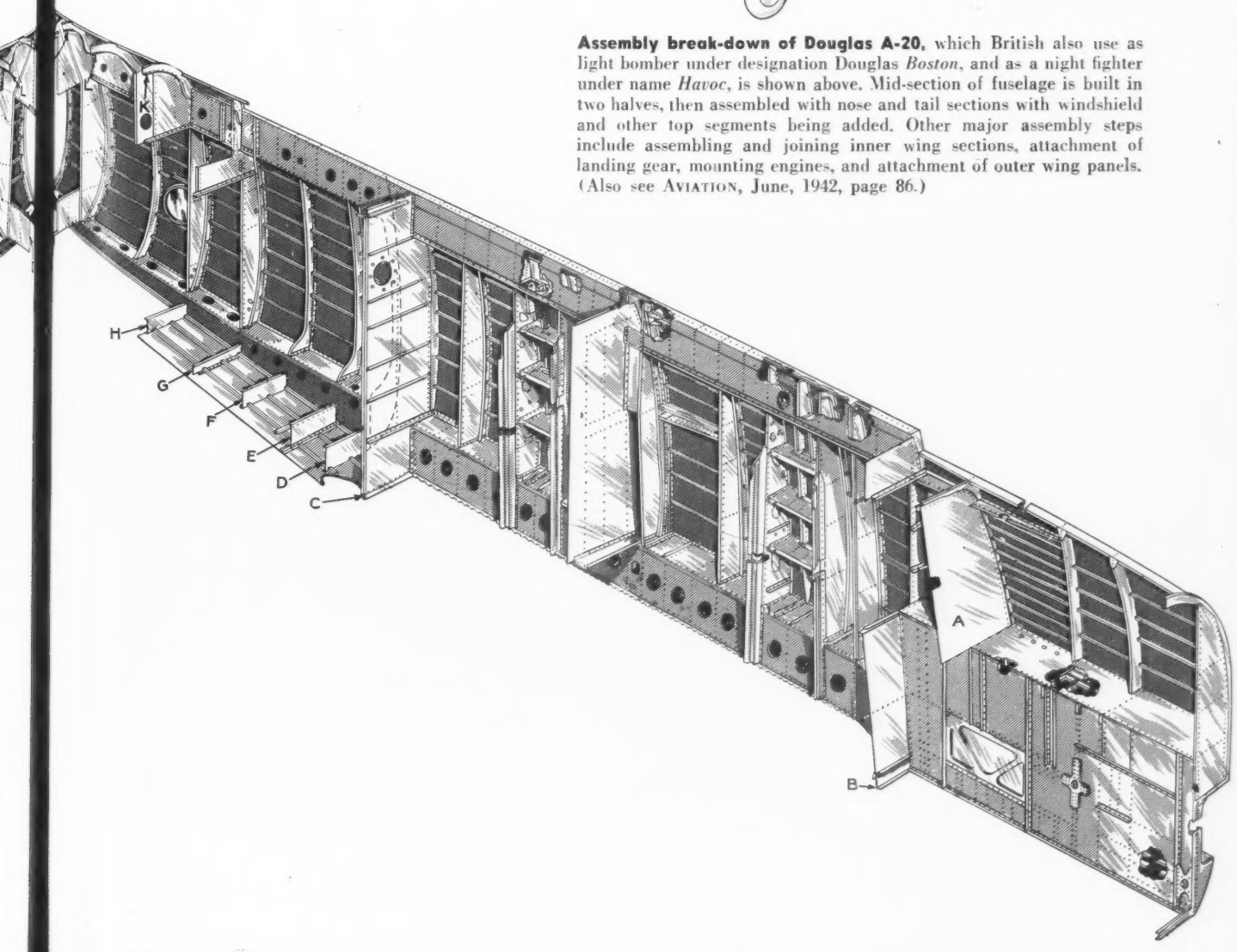


One of many sub-assemblies of Boeing AT-15 made almost entirely of wood is fairing for navigator's compartment, shown here from above before installation of astral dome. As is case with construction elsewhere in plane, framing is of spruce and skin of poplar plywood. (Also see AVIATION's Sketch Book for Jan. 1942.)



Shown above and at right are details of mid-section of Douglas A-20 fuselage, which is built on longitudinal "half-shell plan in which right and left sides are built separately and then joined to make a complete unit. Necessary installations are made on each half prior to their being joined. By constructing fuselage in halves, employees are able to work on both inside and outside simultaneously without crawling into cramped, difficult-to-light places. Among points where two halves are joined to make complete unit are points "A" through "N."





Assembly break-down of Douglas A-20, which British also use as light bomber under designation Douglas *Boston*, and as a night fighter under name *Havoc*, is shown above. Mid-section of fuselage is built in two halves, then assembled with nose and tail sections with windshield and other top segments being added. Other major assembly steps include assembling and joining inner wing sections, attachment of landing gear, mounting engines, and attachment of outer wing panels. (Also see AVIATION, June, 1942, page 86.)

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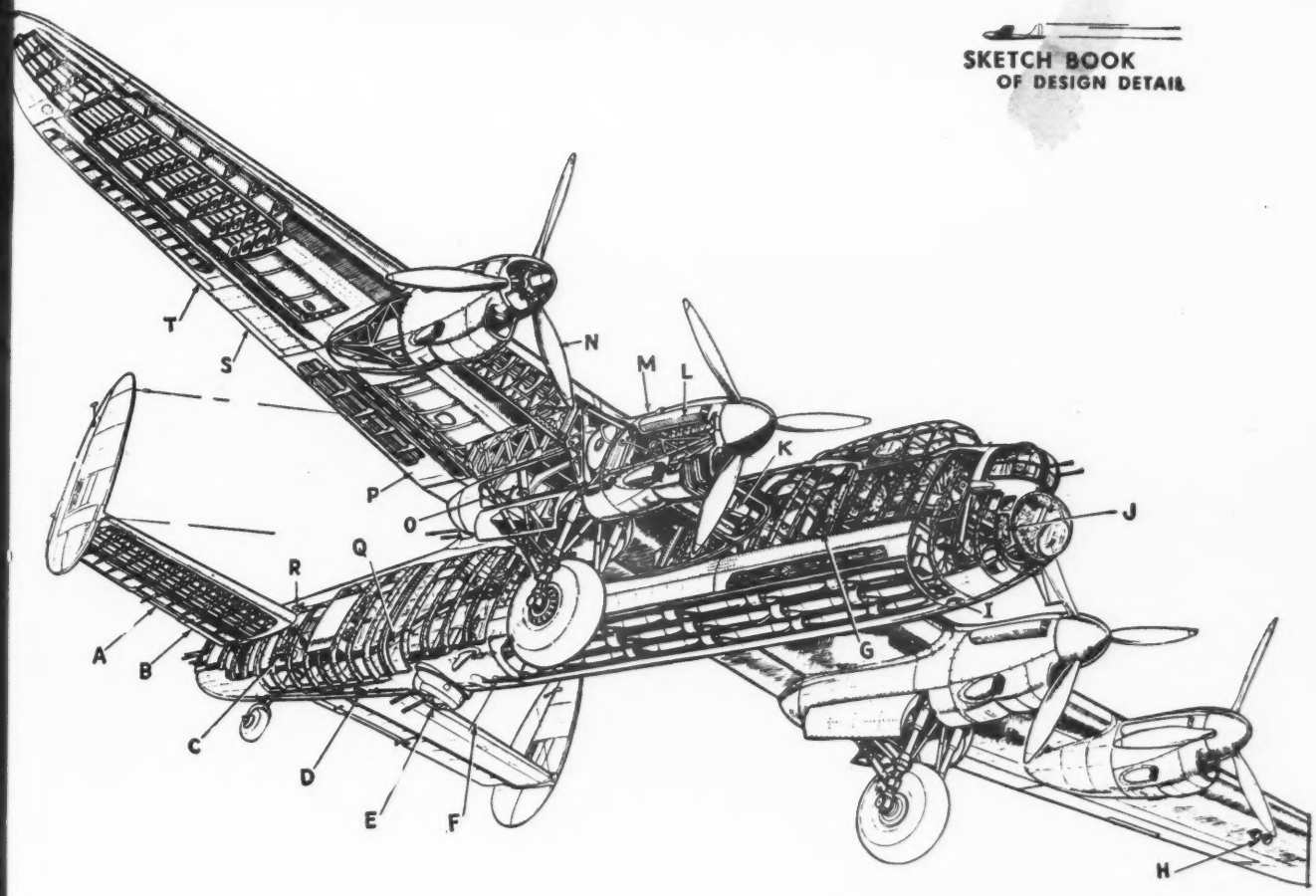

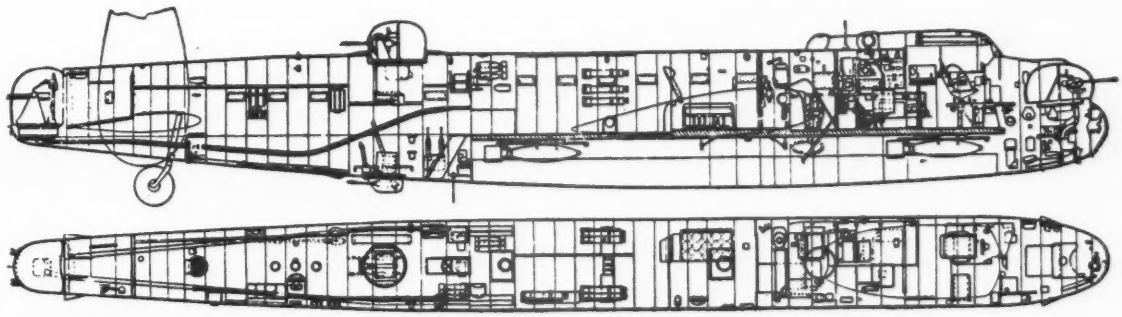

Avro Lancaster is latest of British four engine bombers, which have been used so effectively, not only on raids over Germany but Italy as well. Armed with ten Browning .303 machine guns in four power turrets, it carries crew of six. This cut-away illustration, re-drawn from *Flight*, shows many of its structural details. Reading counter-clockwise from left, elevator balance tab is shown at "A" and elevator trim tab at "B." A first aid kit, accessible from outside, is at "C." Downward identification lights are located at "D," ventral gun turret is shown at "E," and radio ground line, which functions when plane is on ground, is at "F." Principal longitudinal member "G" supports bomb racks and main floor of craft. Retractable landing lights are shown at "H," and a camera is installed just below bombardier's compartment at "I." Automatic pilot is located at "J." Heat for cabin is taken from engine radiator through duct "K." "L" is an exhaust flame damper on one of four Rolls Royce *Merlin* XX engines "M" which turn deHavilland constant speed propellers "N." Hydraulic landing gear retracting jack is at "O," and landing flap is shown at "P." "Q" is ammunition chute for rear gun turret, and "R" is dinghy release handle. Aileron trim and balance tabs are shown at "S" and "T," respectively.

FROM NOSE TO TAIL

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PLEXIGLAS, the crystal-clear acrylic plastic which made possible the familiar bomber nose, as well as other transparent parts aboard every type of Army and Navy plane, was developed in Rohm & Haas Laboratories, first brought into commercial production in Rohm & Haas plants. There the first all-plastic bomber nose was built, and the method for mass production of these curved sections was developed.

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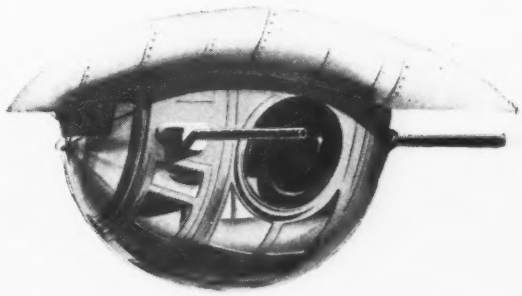

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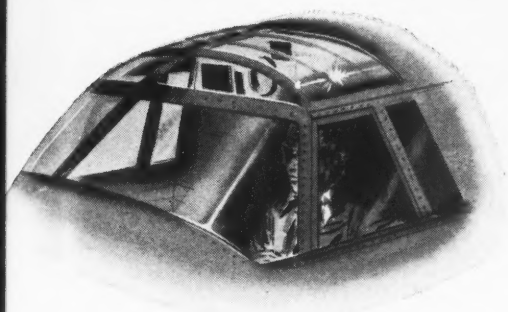
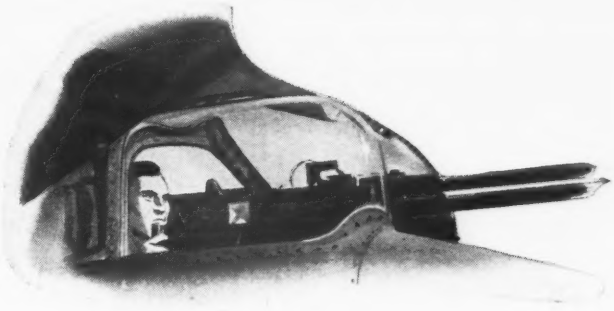


ESCAPE HATCH... *made of PLEXIGLAS*

Over the pilot's head, a sturdy PLEXIGLAS panel provides extra visibility... plus an emergency exit. PLEXIGLAS panels are also used as side windows of the cabin, with a weight saving that helps make possible a bigger fuel or bomb load.



TAIL TURRET... *made of PLEXIGLAS*

Unusual shapes, three-dimensional curves are needed to form the rear gunner's turret. PLEXIGLAS, easily cut and formed into smooth streamlined shapes, fills the bill... just one more reason why it is "Aviation's Standard Transparent Plastic."

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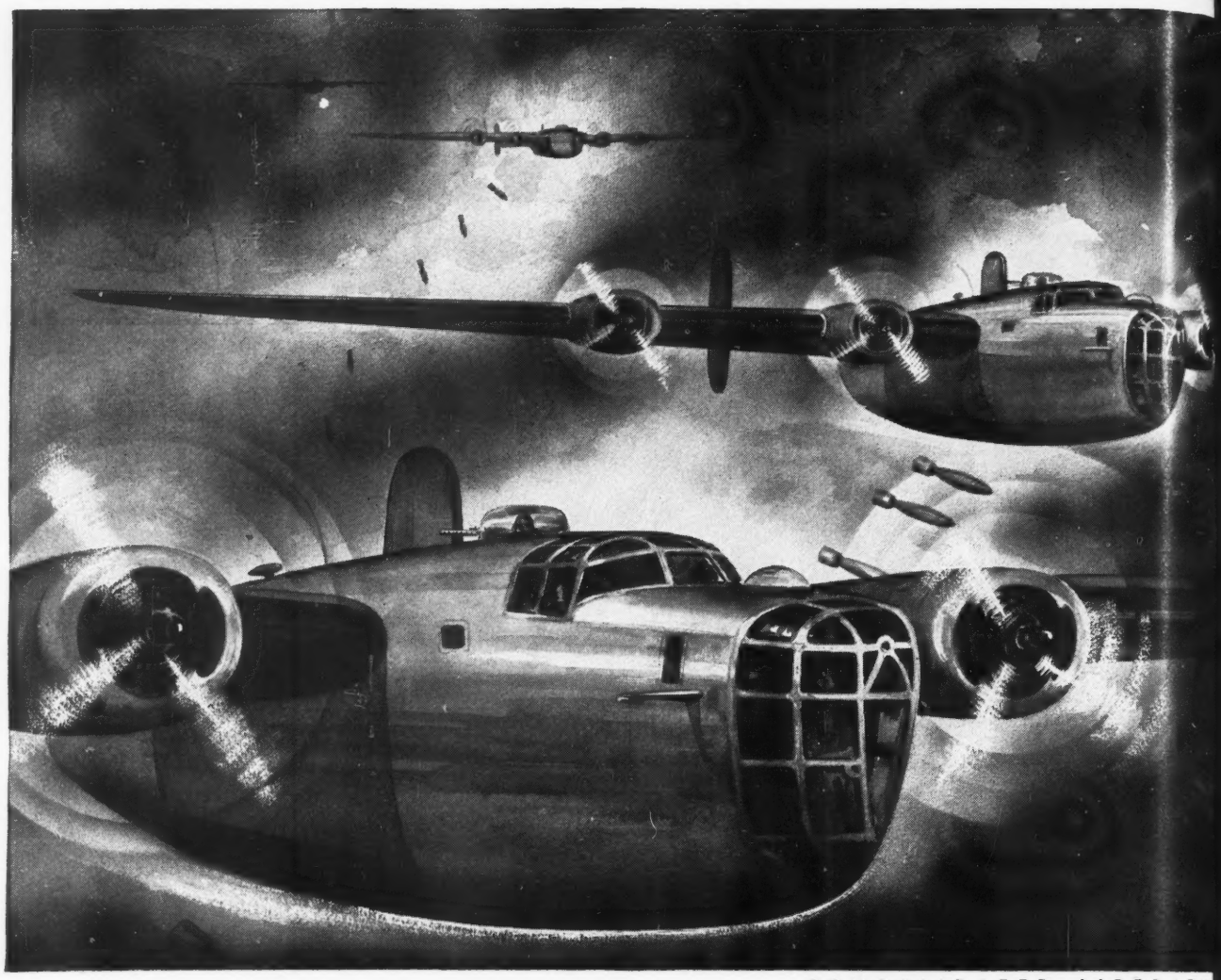

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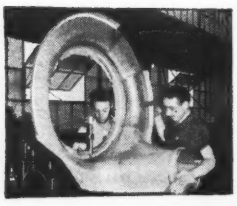

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craft Turnbuckles 1
nformation, sketches, and tables con- ning its aircraft turnbuckles are of- d in four-page folder released by Air- t Standard Parts Co., Rockford, Ill.

w Fans and Blowers 2
Catalog No. 14-A, prepared by Hartzell peller Fan Co., Piqua, Ohio, is 40-page strated and diagrammed catalog de- bing company's axial flow fans and vers.

klet on Welders 3
From Westinghouse Electric & Mfg. Co., t Pittsburgh, Pa., comes new 12-page strated publication describing com- y's Flexarc A-C welders. Designated *Booklet B-3136*, it features 500 amp. ustrial welder for high-speed, continu- welding on all types of heavy con- uction, and 300 amp. portable welder heavy-duty work.

roboscope Uses 4
Eyes for Industry . . . Stroboscopic chnique, is 25-page booklet issued by neral Radio Co., 30 Eighth St., Cam- dge, Mass. Details are included con- ning use of Strobotac unit in instru- nt checks, vibration studies, etc., in craft industry.

tomatic Contour Shaping 5
Recently issued bulletin, *Duplimatic mplifies Difficult Contour Shaping Op- tions*, describes how. Duplimatic auto- tic machine tool control is used to per- t standard shapers to do high-speed tomatic shaping. Bulletin is offered by troit Universal Duplicator Co., 723 E. lwaukee Ave., Detroit.

nnector Designs and Methods 6
Compilation of aircraft connector de- gns, test reports, installation procedures, d circuit identification methods is of- ed in new Burndy *Aircraft Catalog No. 43* issued by Burndy Engineering Co., 9 E. 123rd St., New York City. In- uded is description of Versiflex thermo- stic tubing.

brasive-Cloth Tips 7
Chart prepared by Behr-Manning Corp., vision of Norton Co., Troy, N. Y., is led *Metalite Cloth Gadgets Speed Sand- g*. Company's abrasive cloth "Gadgets" ed in aircraft industry are pictured in e and described.

Electric Control Devices 8
Square D Co., Dept. 41, 4041 N. Richard St., Milwaukee, is distributing new catalog, *Air-Line*, covering firm's electrical control devices. Described are circuit breakers, switches, relays, contactors, pushbuttons, limit switches, and special purpose devices designed for use on aircraft.

Punch, Form, and Rivet Tools 9
In new 48-page *Whitney-Jensen Aircraft Tools Catalog*, issued by Whitney Metal Tool Co., 99 Forbes St., Rockford, Ill., company's various punching, forming, and riveting tools are pictured and described. Introduced are two new tools —the G-742 rivet puller, designed for heading up of blind rivets by one man (working from one side only and without bucking bars) and No. 247 bench-type press break.

Temperature Devices 10
Offered by Scientific Instrument Co., Detroit, is firm's *Catalog No. 142*, 51-page plastic-bound illustrated publication giving specifications of company's many industrial thermometers, temperature control devices, and recording instruments.

Electric Control Systems 11
Catalog N-004, available from Leeds & Northrup Co., Philadelphia, is 29-page photo- and diagram-illustrated publication covering firm's Micromax electric control system for handling processes controlled by positioning valves or other regulating devices. Instruments and applications are described.

Plastics Manual 12
Cellulose Plastics in War and Industry is title of comprehensive, profusely illustrated 64-page manual of specifications, properties, and applications of sheets, pipes, rods, tools, films, foils, molding materials, plasticizers, cement, belts, and glazing materials. Newly issued by Celanese Celluloid Corp., New York City, book covers many aviation uses of firm's product Lumarith.

Oil and Grease Seals 13
New Data on Oilseals and Greaseals is title of bulletin issued by Gits Bros. Mfg. Co., Chicago. Photo- and diagram-illustrated, 16-page tract details recommendations, applications, listings, etc., of firm's positive seal lines used widely in aircraft industry.

Harder Tin-Base Alloys 14
Tin Research Institute, Greenford, Middlesex, England, offers special paper on attainment of harder tin-base alloys through heat treatment. Vickers hardness values of 33 to 34 are reported.

Temperature Instruments 15
Five new bulletins issued by Wheelco Instrument Co., Chicago, describe firm's complete line of industrial indicating, recording, and control thermometers. Well illustrated literature totals 34 pages.

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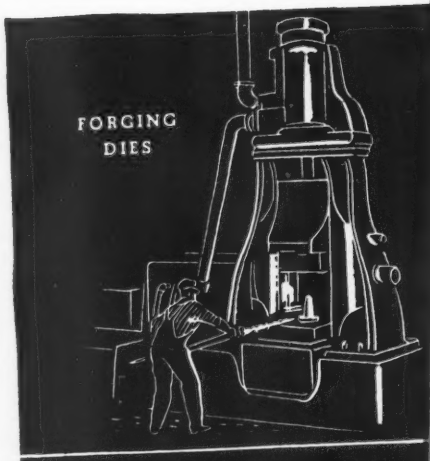
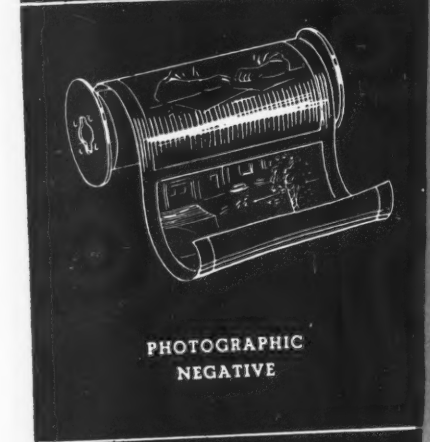


FORGING DIES



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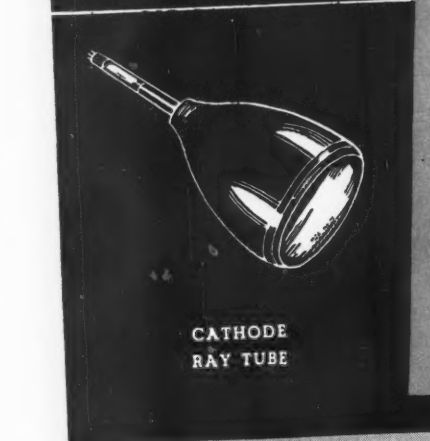

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Magneto Bulletins 16

New sheaf of service bulletins offered by Scintilla Magneto Division, Bendix Aviation, Sidney, N. Y., cover ten subjects. Included: Primary condenser tester, tool for checking magnet end play, ground terminal spring contact, vibrator type booster system, corrosion prevention treatment of magnesium parts, oil seal and sleeve for magneto shaft, and lubrication of breaker cam adaptor gears.

Pulley Brackets 17

New line of universal pulley brackets available for A-N 210 pulleys, sizes 1 to 6, used by aircraft manufacturers are described and pictured in bulletin published by Tinnerman Products, Inc., Cleveland.

Gage Inspection 18

Illustrated color folder available from Perfex Gage & Tools Co., Detroit, describes special temperature-control inspection of company's gages, also pictures several of firm's products.

Connector Plugs 19

Aircraft connector plugs made by Cannon Electric Development Co., Los Angeles, are illustrated and described in special 16-page condensed catalog supplement just published by firm.

Care of Gage Blocks 20

How to Make Your Standards Last Longer, 8-page booklet offered by Dearborn Gage Co., Dearborn, Mich., explains care of gage blocks, and describes firm's working, inspection, and laboratory chromium-plated gage blocks sets.

Century of Progress 21

To commemorate its 100th anniversary, Joseph T. Ryerson & Sons, Inc., Chicago, has published attractively illustrated brochure titled, *100 Years of Peace and War*. Superb drawings and sketches dramatize review of nation's industrial growth during past century. Story opens with reference to Ryerson iron forges of revolutionary war days.

Lathe-Training Aids 22

Varicolored folder being mailed by South Bend Lathe Works, South Bend, Ind., describes films, instruction books, bulletins, wall charts, and blueprints on lathe operation, which firm has prepared to speed training of new workers.

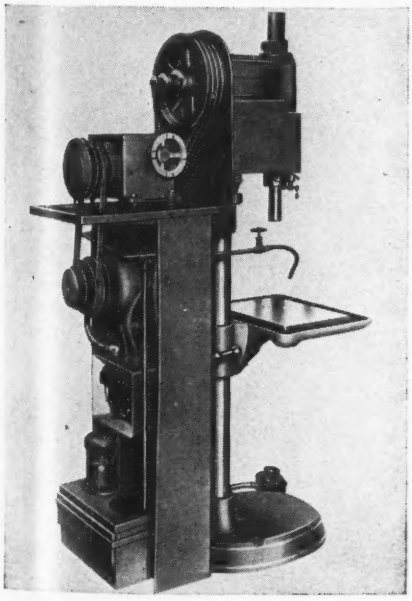
Rate-of-Flow Meters 23

Theory of the Rotameter is special 12-page publication issued by Fischer & Porter, Hatboro, Pa. Given is thorough technical explanation of rate-of-flow meters with pertinent tables and diagrams.

Latest Machine Tools

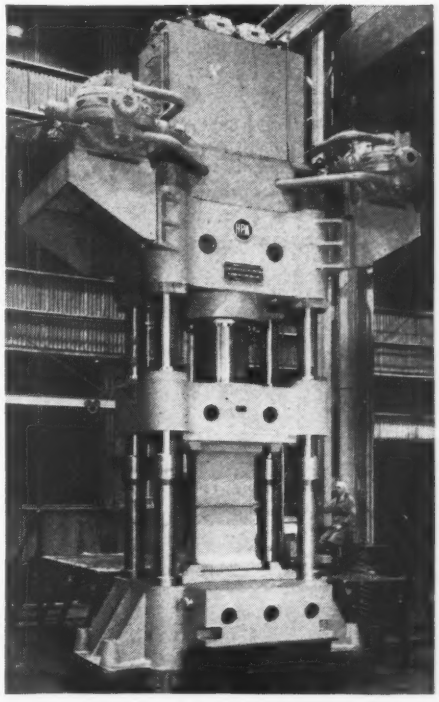
Heavy Duty Tapper.....24

New 16-speed heavy duty lead screw tapping machine, with capacity of 1¼ in. N. C. in steel, has been brought out by **Cleveland Tapping Machine Co.**, Cleveland. Known as Model DB, unit suitable for aircraft precision work is dual push button controlled for either automatic or manual operation. Sensitive reverse control adjustment, via dial indicator, is stated to be capable of holding vertical travel of spindle within a 0.005-in. limit, and the rotational motion of spindle can be reversed within a maximum of a quarter turn of spindle at moment of reversal. Incorporated are 4-speed transmission and 4-step V-drive pulleys, with final drive through four-groove sheave with sensitive clutch for tap protection. Speed range is 45 to 300 rpm. Unit comes with 3 hp. motor, oil pump and tank, and No. 4 MT spindle. To show machine's construction, housing has been omitted in photo.—AVIATION, *Feb.* '43.



1,000-Ton Forging Press.....25

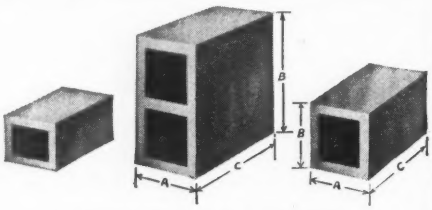
New 1,000-ton H-P-M Fastraverse self-contained open forging press is latest development of **Hydraulic Press Manufacturing Co.**, Mount Gilead, Ohio. Huge unit has motor-driven hydraulic pumps mounted directly to press cylinder, with provision for prefilling and exhaust of main cylinder during rapid traverse ram movement, thus no auxiliary steam boilers, hydraulic accumulators, or intensifiers are employed. Direct communication is via overhead oil tank and main cylinder through valve in cylinder head. With speed metered by radial hydraulic pump, press closes and opens at rate of 560 in. per minute, and pressing speed is 105 in. per minute. Unique feature is ram-travel reversal without operating valve. Instead delivery of radial pump is reversed, providing for shockless reversal controlled manually by hand lever. Specifications—Pressing surfaces (L-R xF-B): platen 72x48 in., bed 72 x 111 in., bolsters (u. & l.) 68 x 48 x 9 in. thick, die blocks (u. & 1) 36 x 12 x 30 in. high; daylight openings (max.): platen to bed 108 in., between die blocks 30 in.; ram travel (max.) 42 in.; motors required (hp. x rpm.) (two): 200 x 720; shipping weight 244,500 lb.—AVIATION, *Feb.*, '43.



New Boring Machine.....26

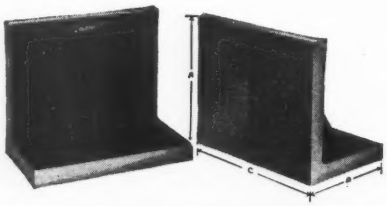
In production at **Century Engineering Co.**, Los Angeles, is new bench model precision machine for boring holes ⅜ in. dia. to 2¾ in. dia. to tolerances of a few ten thousandths. Parts with parallel sides adjacent to hole are held by fixture, which is removable for attachment of other holders for unsymmetrical parts. Slide is air and hydraulically operated,

Specify CHALLENGE SURFACE PLATE EQUIPMENT



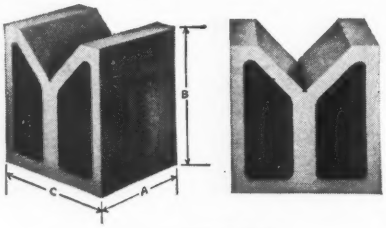
BOX PARALLELS

Made of high grade, special analysis, fine-grained, semi-steel castings—square and accurate—all four walls equal in thickness. Special heat treated and precision ground. Made in 12 regular sizes; also four sizes of cube box parallels. Challenge also manufactures semi-steel Solid Parallels in 12 sizes.



ANGLE PLATES

These plates provide a practical and versatile method for clamping and holding work. Made of high grade, fine-grained semi-steel—special heat treated and precision ground. Furnished in 22 sizes. Write today for further details.

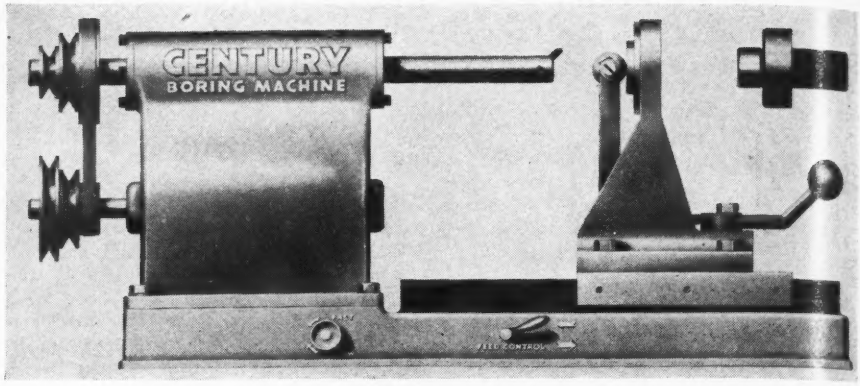


V-BLOCKS

Recommended for checking, inspecting, or layout of center lines and holes on all sizes of round work. Made from fine-grained semi-steel castings. Special heat treated and precision ground. Ribbed sides provide strength and light weight and furnish a convenient means for clamping. Five standard sizes. 439

LATEST CATALOG illustrates and describes the complete line of Challenge Precision Equipment. Send for it at once!

THE CHALLENGE MACHINERY CO.
GRAND HAVEN, MICHIGAN

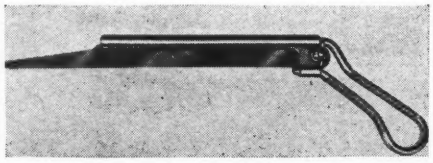


and metering valve adjusts feed speeds of fixture on slide, moving work toward boring bar, then quickly retracting it when cutting is completed. Boring bar spindle is actuated by 110-v. motor, with three-speed pulley permitting changes in spindle speed. Furnished is set of locating plugs and bushings from $\frac{3}{8}$ to $2\frac{1}{4}$ in. dia., divided in increments of 1.16 in., to be used with universal fixture, also six boring bars from $\frac{3}{8}$ to $2\frac{1}{4}$ in. capacities.—AVIATION, *Feb.*, '43.

Shop Equipment & Accessories

Low-Angle Hacksaw 27

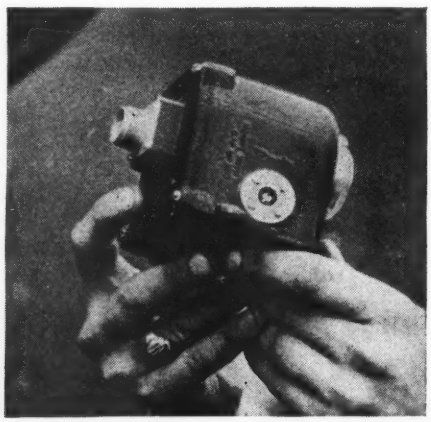
From **New Britain Machine Co.**, New Britain, Conn., is available low-angle hacksaw frame suitable for numerous



shop jobs. Frame comes equipped with a wave-set 10 in. blade. Broken blades can conveniently be fitted into frames, work equally well. Tool is 13 in. in length.—AVIATION, *Jan.* '43.

Anti-Fire Impact Unit.....28

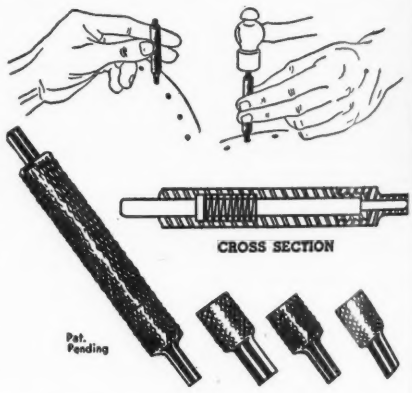
Illustrated is impact switch, designed for Army and Navy, which automatically discharges several pounds of fire-killing liquid carbon dioxide into engine compartment of combat plane in event of a crash. Developed by engineers of **Walter Kidde & Co.**, Bloomfield, N. J.,



switch contains trigger device adjustable to go off only under a force greater than any encountered during sharp dives and twists of aerial dog-fighting or rough landings on bumpy fields.—AVIATION, *Feb.*, '43.

Sleeved Transfer Punch.....29

New aircraft worker's transfer punch, called the Caffin Tru-Punch, is a sliding tool within a sleeve and with the end of



the sleeve machined to template hole diameter. With interchangeable tips for holes to $\frac{5}{16}$ in. dia., punch is stated to tranfer hole locations accurately to 0.001 in. Standard tips are available for Nos. 30, $\frac{3}{32}$, $\frac{7}{64}$, $\frac{1}{4}$, and $\frac{5}{16}$ template holes. Maker is **Tru-Punch**, Scotch Plains, N.J. —AVIATION, *Feb.*, '43.

Portable Plane Lift.....30

Designed for aircraft service and maintenance operations at airports and assembly work in plants, a new portable hydraulic airplane lift is announced by **Globe Hoist Co.**, Philadelphia. Known

The remarkable precision which characterizes modern aircraft production, finds its counterpart in the formulation and manufacture of Berryloid Aircraft Finishes. The uniformity and dependability of these famous finishes, carefully maintained by continuous laboratory tests and production control, play an important part in facilitating maximum Allied plane production. The most famous American and Canadian fighters, bombers and trainers are finished with Berryloid materials.

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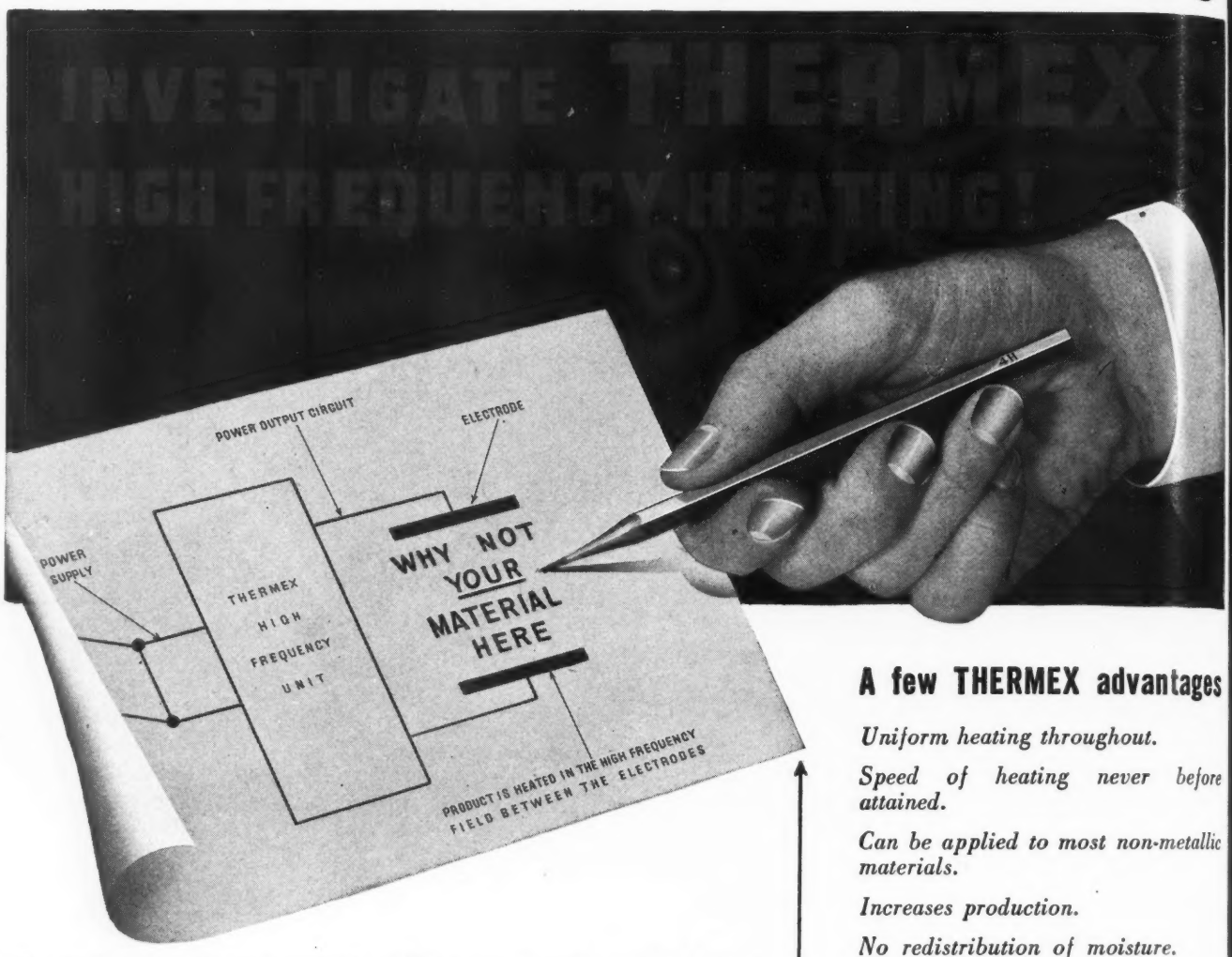

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Are you a builder or sub-contractor of assemblies and sections for wood planes and gliders? Then here are three important reasons why you should *immediately* consider the use of Thermex:

1. *Thick* sections completely bonded in a few minutes.
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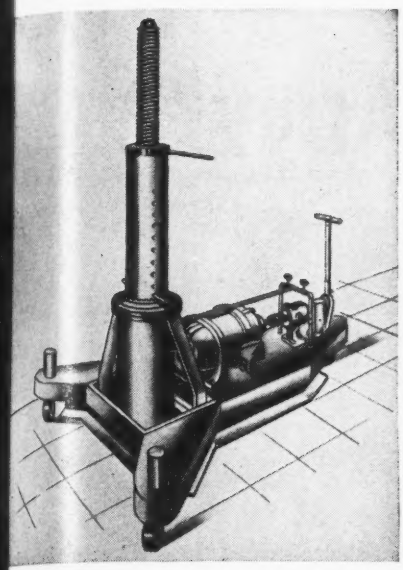


s Type A-70, unit's entire lifting mechanism, cylinder, plunger, oil reservoir tank, pumping unit and electric motor is mounted on base plate suspended independently from chassis. Under load, base firmly engages floor, while without load it rides free for wheeling about floor. From "down" position of 50 in., power lift is $27\frac{5}{8}$ in., plus hand-adjustment rise of $33\frac{3}{4}$ in. or a total of $111\frac{3}{8}$ in. Maximum lift capacity is 21,000 lb., and sustaining load capacity is 63,000 lb. Power is provided by 5 hp., 220-v., 3-phase, 60-cycle motor.—AVIATION, *Feb.*, '43.

Inverter Ballasts 31

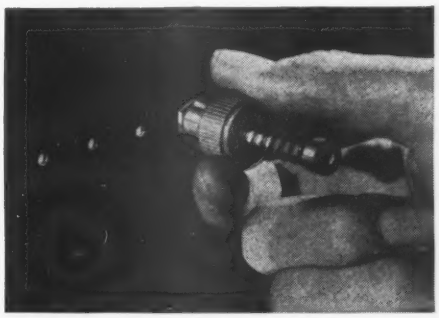
General Electric Co., Schenectady, announces new d.c. to a.c. inverter ballast for fluorescent lighting of aircraft instruments and indicators. Ballast provides output voltage suitable for operation of two 4-w. Mazda F lamps, designated as T-6x$2\frac{1}{2}$, FA-5 (pinless) blue F-6 lamps, for instrument panel lighting. By means of second winding, there is also 3-volt, 1.5 amp. output supply for such lamps

NEW PRODUCTS

as 0.19-amp., 3-volt, T-$1\frac{1}{4}$ lamps for indicator lights. Weight of unit is $2\frac{1}{2}$ lb.—AVIATION, *Feb.*, '43.

Blind-Side Burr Tool.....32

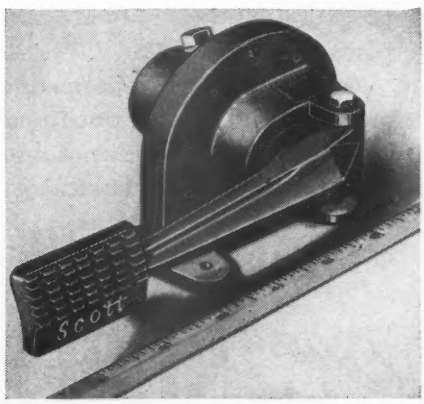
Burzit, new small cutting tool announced by **Scovill Mfg. Co.**, Waterbury, Conn., is designed for quick removal of burrs, from blind-side holes



in aircraft skin sheets. In operation, spring is compressed and burr remover inserted in rivet hole, then spring pressure pulls blade back against skin sheet. One clock-wise turn of tool removes burr. Flat bearing section on blade prevents cutter from countersinking or thinning sheet. Units are for $\frac{3}{32}$, $\frac{1}{8}$, $\frac{5}{32}$, and $\frac{3}{16}$ in. rivet holes. Each is fitted in container marked for identification.—AVIATION, *Feb.*, '43.

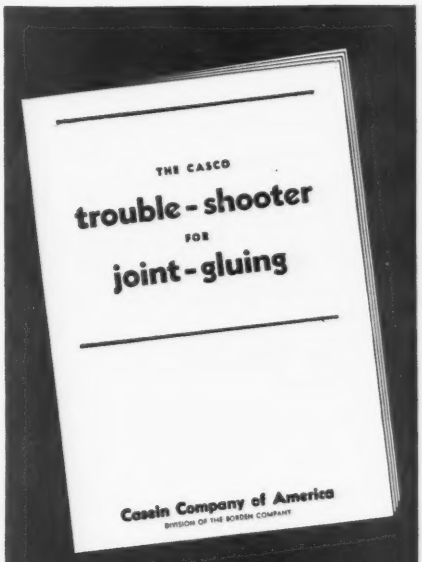
New Brake Unit.....33

Brake pressure cylinder, Model B-711, for use with hydraulic brakes on many



types of planes, has been designed by **Scott Aviation Corp.**, Lancaster, N. Y. Unit weighs 23 oz., comes with installation instructions. Pedal location is similar to front brake pedal location. —AVIATION, *Feb.*, '43.

NEW TO GLUE?



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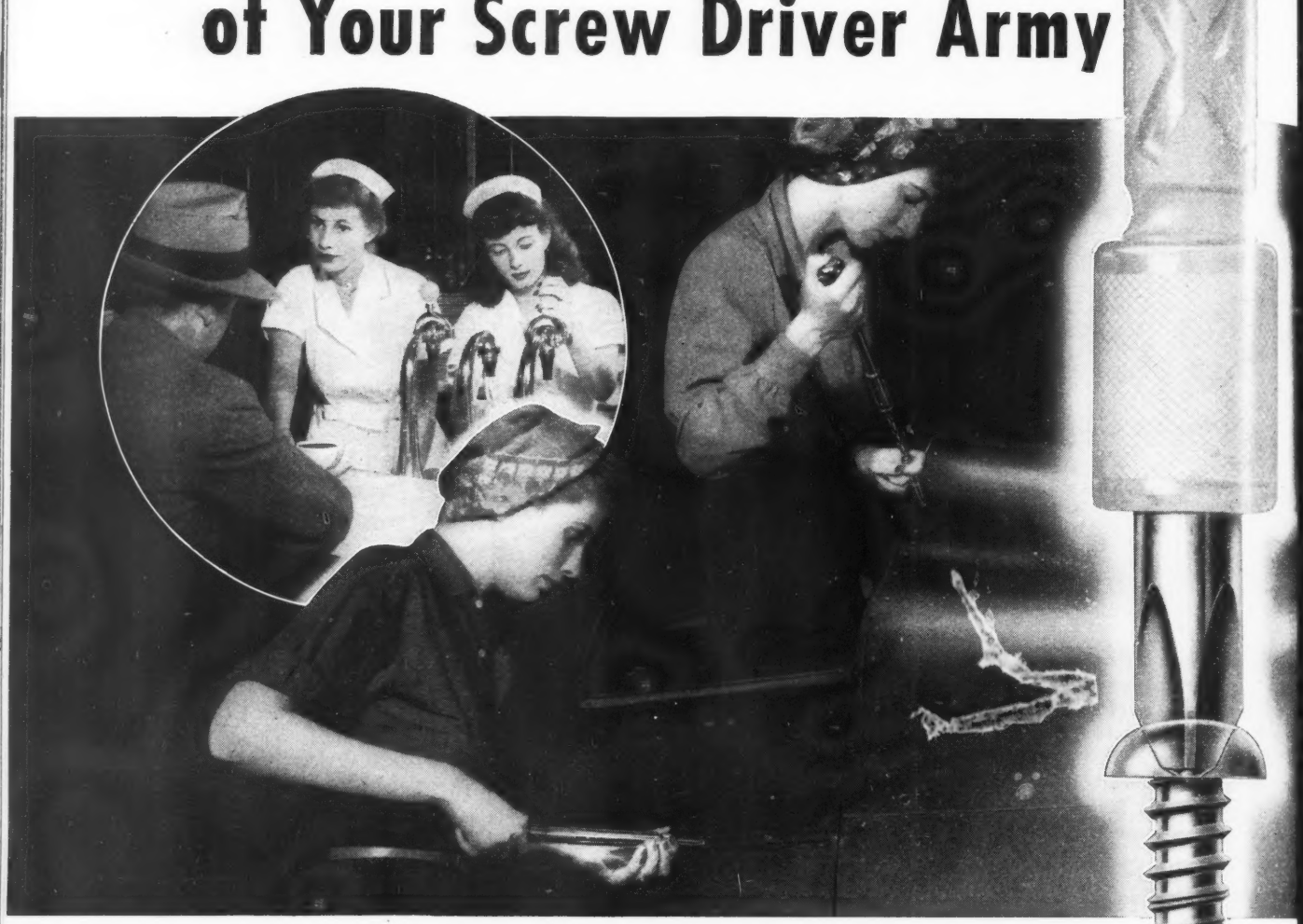

ANYONE CAN DRIVE PHILLIPS SCREWS!

In many of today's war-expanded plants, *raw recruits* now literally walk from the employment office into responsible screw-driving jobs previously rated as skilled work. They produce efficiently, too, because the job is simplified and made foolproof by Phillips recessed head Screws.

The Phillips driver centers *automatically* in the recess . . . can't slip out to injure hands or spoil the work. This means centered *driving force* . . . no fumbling, wobbly starts . . . no slant-driven screws . . . no burred or broken screw heads.

Snug fit and perfect centering of driver in the Phillips Recess enable workers to make *uniformly tight* fastenings . . . and do it with *less effort.* Driving speed is often *doubled* because easy-driving, skid-proof Phillips recessed head Screws make power-driving practical!

They cost less to use! Compare the cost of driving Phillips and slotted head screws. You'll find that the price of screws is a minor item in your total fastening expense . . . that it actually costs less to have the many advantages of the Phillips Recess!

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The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting – Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

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Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

PHILLIPS *Recessed Head* SCREWS

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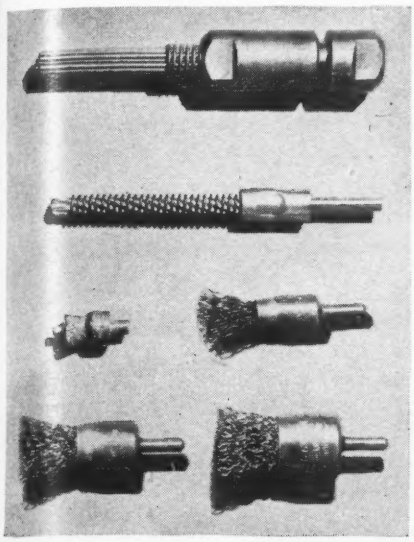
21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester,
Reading Screw Co., Norristown, Pa.
Pheoll Manufacturing Co., Chicago, Ill.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Co
Whitney Screw Corp., Nashua, N. H.

Shaft-End Brushes 34

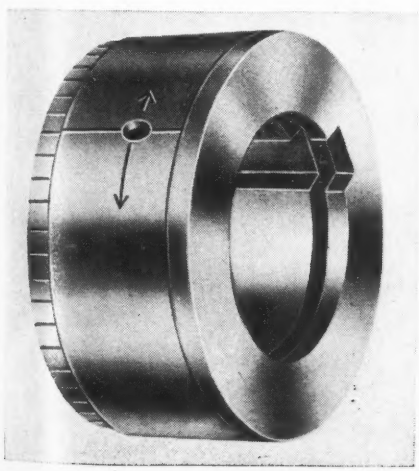
End brushes, designed to revolve on ends of power shaft and find way into crevices, grooves, holes, and indentations, to clean, chip, and polish, are marketed by **Osborn Mfg. Co.**, Cleveland. Brushes in photo (top to bottom): Weld cleaning brushes, cable end



brush adapted to turning bends and cleaning hard-to-reach places, end bonding brush (left) for cleaning zinc chromate from around rivet holes in airplane structures, and a series of three end brushes of varying sizes for jobs such as cleaning motors, pistons, and cylinder heads.—AVIATION, *Feb.*, '43.

Adjustable Spacing Collar....35

Improved heavy-duty adjustable spacing collar for milling machine cutter arbors is announced by **Dayton Rogers Mfg. Co.**, Minneapolis. Made in six sizes, collars have maximum over-all



width to compensate, when necessary, for severe tightening of arbor nut on heavy production requirements. Maximum over-all adjustment is $\frac{1}{8}$ in. by half thousandths. Engraved indicator shows which way to make needed adjustment.—AVIATION, *Feb.*, '43.

Gear and Wheel Puller.....36

Added to line of **Armstrong-Bray & Co.**, Chicago, are new Steelgrip rigid-arm gear and wheel pullers. Units are made in three sizes to care for wide range of plant machine, tractor, and truck maintenance jobs.—AVIATION, *Feb.*, '43.

Plastic Spray Gun.....37

Eclipse Air Brush Co., Newark, N. J., now offers spray guns with black plastic bodies. Strong plastic, providing lighter weight gun, is designed for good impact strength with resistance to thinners, solvents, paint removers, etc.—AVIATION, *Feb.*, '43.

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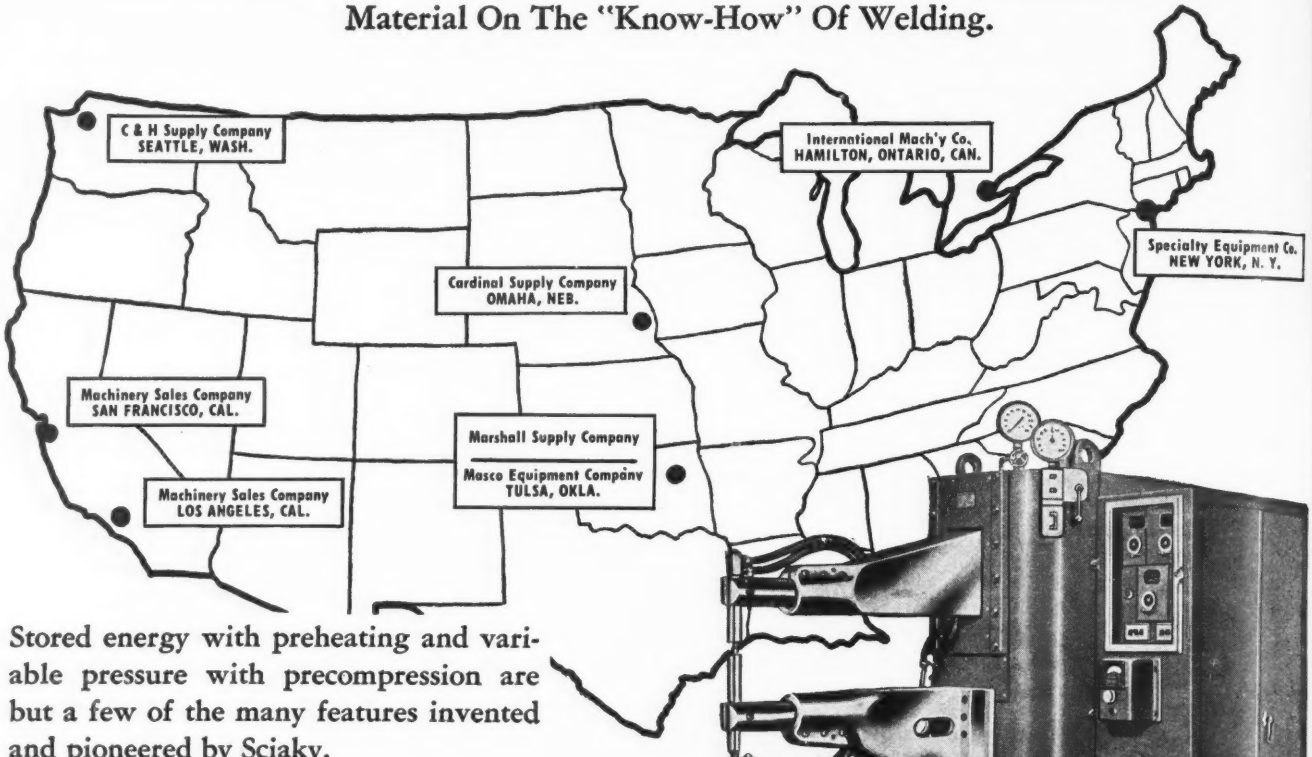

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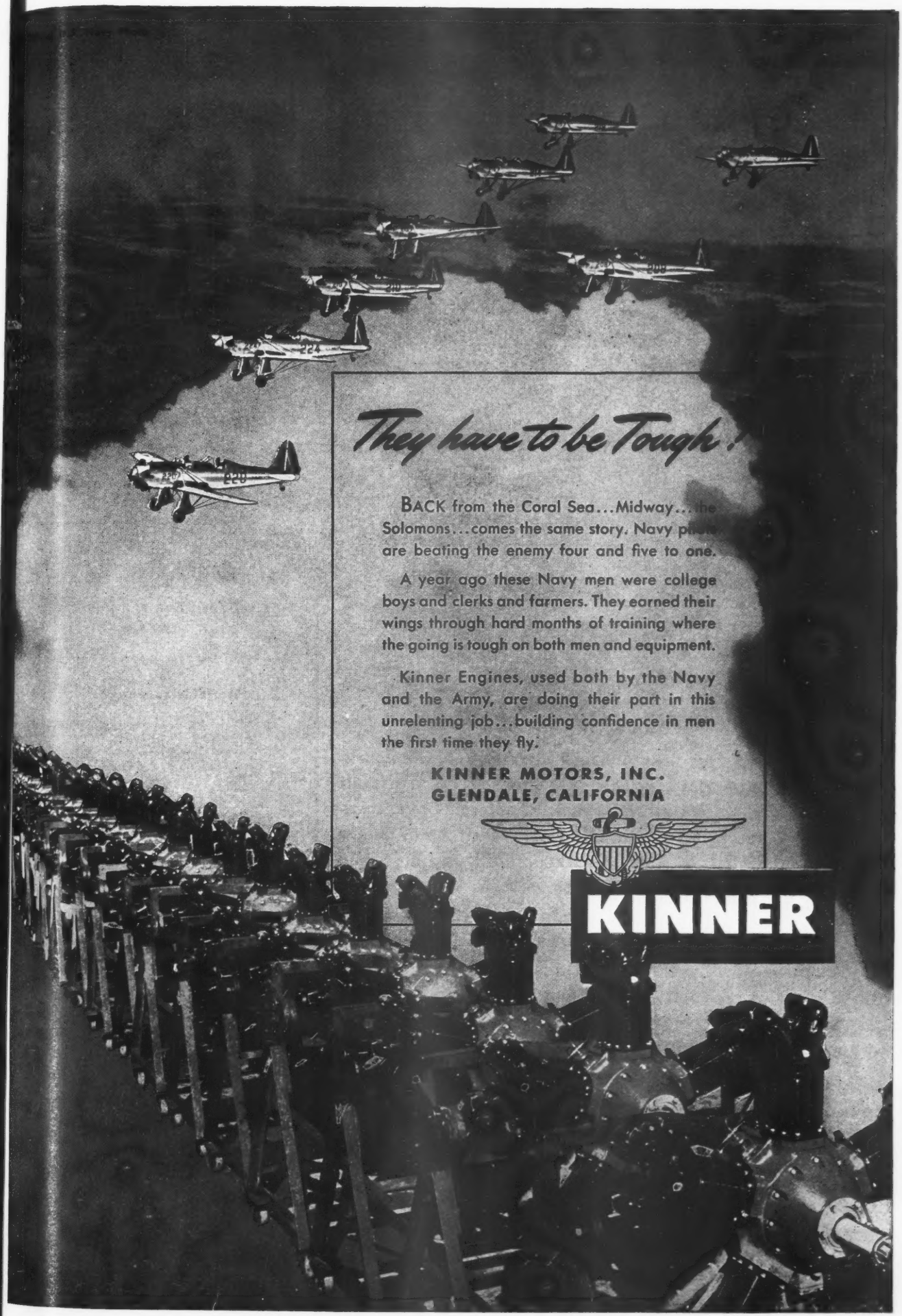
STORED ENERGY · VARIABLE PRESSURE
WITH PREHEATING · WITH PRECOMPRESSION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A year ago these Navy men were college boys and clerks and farmers. They earned their wings through hard months of training where the going is tough on both men and equipment.
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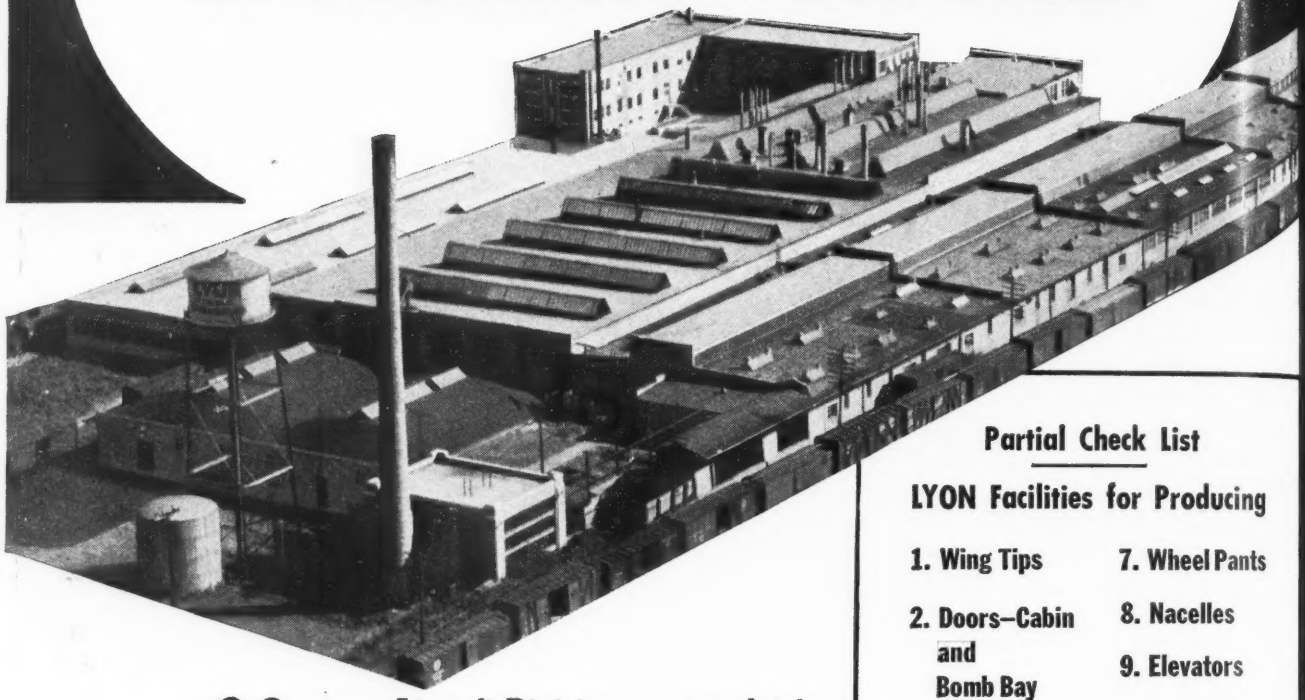

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Will Take Wood Jobs.....S-137

Well-equipped and long experienced, an Indiana manufacturer of quality hardwood products, furniture, and prefabricated cabinetry has productive capacity available to prime contractors for subassembly or processing work in the aircraft field. Recently, firm has designed and built special wood units for government projects. Personnel includes 200 skilled and semi-skilled wood machinists and cabinet makers. Modern, five-building plant affords 150,000 sq. ft. of floor space, and there are complete handling, loading, and shipping facilities. Complete lumber-drying kiln has approximate capacity of 150,000 board feet per month, and heated lumber shed has similar capacity. Machines and other equipment—Planers: two, roughing and 36-in. cabinet; saws: ten, including two cut-off, three rip including hand-feed unit, two band with 16- and 30-in. wheels, and three miter of tilting mandrel, tilting table, and 14-in. type; jointers: four, including one face and one hand-cabinet; equalizers: two, one hand-feed; two moulders; lathes, two, automatic turning and hand turning 15-in. dia. 8-ft.-0-in. long; double-end tenoner; sanders: thirteen, including one 43-in. drum, two flatbed, seven belt with one 8-in. edge unit and one 72x60-in.-bed automatic, also standard profile, four-brush profile, and 18-in. horizontal borers: two, single-spindle vertical and 4-bit automatic horizontal; hollow chisel mortising machine; shapers: two, 15,000-rpm. double spindle and 7,200-rpm. single spindle; glue process equipment: two 40-section clamp carriers, two plate spreaders and one rotary spreader, horizontal hand glue press, and 3-gal. glue maker; clamps: nine, including five flat-case of 54x30-in. and four revolving-case of 90-in. capacity; dovetailers: two, 10- and 20-bit; also 10,000-rpm. router and a post drill. Likewise included are two air compressors capable of maintaining 100-lb.-sq.-in. pressure, nine spray booths, a repair-and-sharpening tool room. In addition there are such portable tools as routers, shapers, jointers, drills, planes, pneumatic and electric sanders, bar and "C" clamps, etc. Also there is complete warehouse conveyor equipment.

Electrical Unit Facilities...S-138

Because of government curtailment of ordnance production, an East Coast manufacturer of heat controlling devices which have required a high degree of ability in management, design, and machine and assembly work, now has facilities available for production of aircraft electrical mechanisms and other precision parts.

Metal-Parts Capacity.....S-139

West-central Ohio plant, which in peacetime made custom auto bodies, and which has since employed its skilled workmen and craftsmen in the production of tools, jigs, dies, and various sheet metal and light structural parts for the Air Corps and for plane manufacturers, reports it currently has

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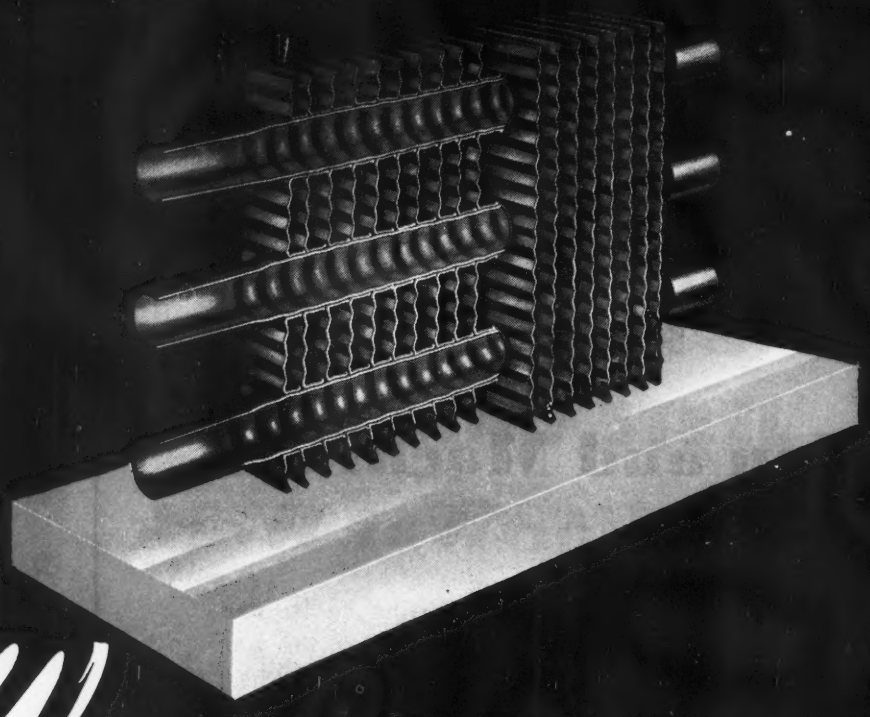

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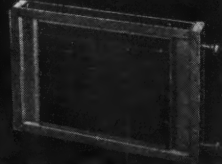

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apacity available for further aircraft ork. Experienced in handling sheet tainless steel and sheet aluminum, ompany has hydraulic and punch resses and drop hammers for forming heet metal parts, as well as adequate hears, saws, and brakes. Also listed re machines and trained personnel for lame, arc, and spotwelding of mild teels, steel alloys, and stainless steel, lso for flame-welding aluminum sheets. n field of structurals, company has one considerable forming, welding, and utting of tubing, as well as angles, hannels, eye sections, etc. Capacity is pen on machine shop units (including athes, mills, planers, drill presses, etc.). Among aircraft items which plant has roduced are ducts, elbows, etc., of sheet luminum, and tailpipe troughs of tainless steel. It has drilled, milled, nd handled forming operations on luminum extrusions, tow bars, and en- ine, fuselage, and hoisting slings made f plate, tubing, structurals, and cable.

Can Do Metal Work.....S-140

Equipment and personnel adaptable or production of aircraft metal work an be made available by a Wisconsin anufacturer of sheet metal products. ast production by firm has been en- rely to customer's specifications, engineering department personnel being highly trained in interpreting customers' needs from their blueprints. Though company has not as yet done work directly for aircraft manufacturers, it has handled considerable number of subcontracts on small items going into various aircraft production parts. Machine tools—Three press brakes capacities 15 to 110 tons, distances between uprights from 3 to 10½ ft.; also box brake and forming brake, each 6 ft., manually operated; 18 punch presses, of flywheel and geared types, capacities from 12 to 70 tons, bed plates 12x12 in. to 22x48 in.; hydraulic press, capacity 200 tons, bed plate 44-in. dia.; seven vertical drill presses, capacities ½ to 4 in., measurements (spindle center to column) 5 to 13 in.; six other drill presses, including radial, bench, and back geared types; cutting equipment: nine shears of varying types, including capacities #7 to #16 gage, shearing lengths 6 to 10 ft., throats 30 to 54 in., with circle cutting and flanging devices; also turret nibbler, capacity ¼ in., throat 36 in., with circle cutting device; rolls: two hand types, lengths 30 and 42 in., gages #20 and #16, min. dia. 2 and 3 in., respectively; two 6-ft. long power type rolls, one with ¼-in. capacity for total length, min. dia. 6 in., other #14 gage capacity, min. dia. 5 in.; also 48-in. powered forming roll and six assorted hand-operated metal-forming rollers; beading machines: three of #16 and #18 gage capacity, throats 24 and 27 in., also #18-gage capacity turning machine, min. dia. 3¼ in.; spotwelders: 15 (8 manual, 2 automatic, 5 motor-driven) from 10 to 75 kva., including 2-pc. capacities, #7 to #14 gages, and 30 to 38 in. throats; arc welders: five, 125 to 300 amp., 7½ to 15 hp., 35 and 40 v., welding ranges 20 to 375 amp.; also 75-amp. generator electric arc welder and 35-kva. electric unit for continuous electric seam welding; grinders: four, one 2-wheel, 1½x13-in. dia., 3,000 rmp., 1-in. dia. shaft, others face and emery wheel units; polishing lathes: three, 2-wheel, 5x16-in. dia., 2,400 and 3,000 rpm., 1¼-in. dia. shafts; riveting machines: three, two with capacities 3/16 & 9/64-in. dia. and ⅛-in. dia., 24 and 7-in. throats, respectively, and one, capacity ⅜-in. solid rivet, 20-in. throat; three air compressors; lathes: five (three engine and two bench, with four adapted to thread cutting) 8 to 20-in. swing, one is 10 ft. between centers and others 28 and 30 in.; two shapers, 12- and 24-in. stroke; milling equipment: two machines, one slitting, other milling unit with dividing & vertical head attachment; planer, 22-in. between uprights, 48-in. table, 20-in. height; metal band saw, 18-in. throat; also other miscellaneous equipment.

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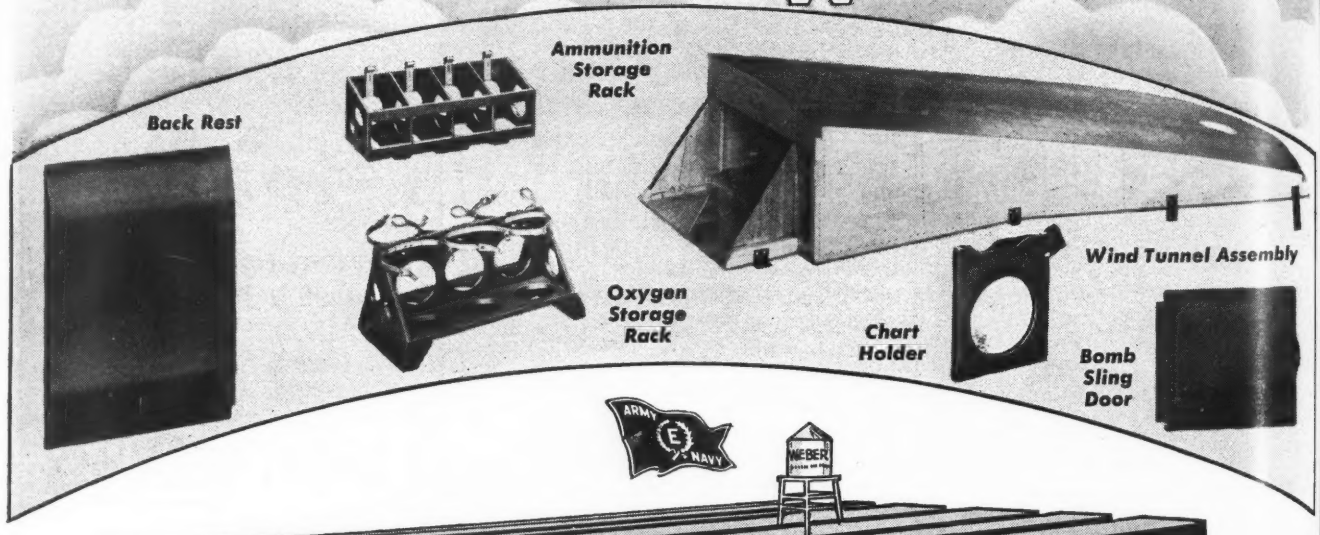

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Capt. Mainwaring was leading a flight of Airacobras over New Guinea on May 29 when one of his planes was attacked by eighteen Jap fighters. Turning back he shot down the leader of the enemy formation and scattered the others. He then reformed his own group and made a co-ordinated attack, destroying three more and possibly shooting down two others.

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The day is coming when Allied Victory will end this war. An advanced world of air-borne commerce will follow. Then, all of our engineering skill and resources will turn from the needs of war to building planes for the needs of Peace. © Bell Aircraft Corporation, Buffalo, New York.

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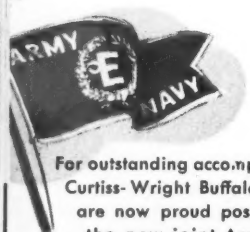

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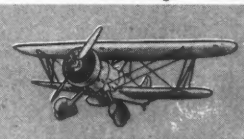
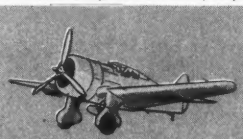


1932 • The first Curtiss plane designed specifically as a fighter-bomber... a single seater, it was used by the U. S. Navy for operation from aircraft carrier

1937 • First fighter-bomber to use retractable landing gear—used by the Navy and by China, Argentina and Siam. Wing bombs were also carried



1938 • The Hawk 75...a monoplane fighter-bomber, incorporating heavier defense armament, increased maneuverability and carried a greater bomb load

1940 • Curtiss P-40 Tomahawk...equipped the R.A.F. in the middle East and the American Volunteer Group in China, Java and Burma

OF INDUSTRY FACTS, FIGURES, PERSONNEL, AIRCRAFT AND ENGINES, EQUIPMENT, MATERIAL

The World's Leading Operational Aircraft 181-239

Thirty pages of photographs, three-view silhouettes and textual data. As an aid to recognition instructors, pilots, anti-aircraft gunners and spotters, these pages are so arranged that the photographs and silhouettes may be clipped and pasted on cards, with the printed data folded on the back.

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Directory of Suppliers' Addresses and Personnel 311

Alphabetical listing of aviation suppliers with addresses and names of key personnel regardless of products supplied.

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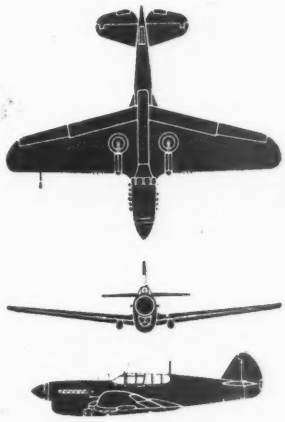
Bell P-39 *Airacobra*

An outstanding medium altitude fighter powered by an 1150 hp. V-type liquid-cooled Allison engine mounted behind the pilot. Propeller is driven by an extension shaft. Armament consists of one 37-mm. cannon firing through the propeller hub and a varying number of 50- and 30-cal. machine guns. In service in the South Pacific, the Aleutians, England and Russia. An all-metal low-wing monoplane with 34-ft. span, 29-ft. 9-in. length and 9 ft. 2¾ in.-height. Top speed is in excess of 380 mph.

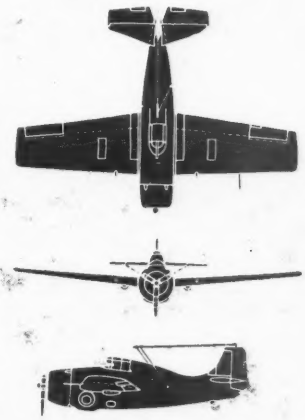
Curtiss P-40F *Warhawk*

This latest development of the P-40 series is the first to be powered by the Packard-built *Rolls-Royce*, V type, 1200 hp. engine. Top speed is over 380 mph. It is an all metal low wing monoplane with span of 37 ft., length, 31 ft. 8 in., height, 10 ft. 7 in. Armament has been increased to a minimum of six 50-cal. machine guns fixed in the wings. This plane, like its predecessors, operates in the widest variety of climates, and with auxiliary tanks, performs medium range missions of every description. Its scores in combat have proved its usefulness.



Grumman F4F *Wildcat*

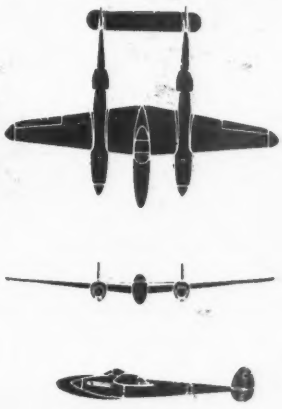
Credited with bringing down more Jap *Zeros* than all other planes combined, this carrier-fighter is also extensively used by the British as the *Martlet*. Press dispatches from the South Pacific report that it has also been widely used as a land-based fighter, rendering exceptional service in the Battle of Guadalcanal. It is also built by Eastern Aircraft Division of General Motors under the Navy designation, FM-1. Powered by a 1200 hp. Pratt & Whitney engine, top speed is over 300 mph. Span is 38 ft., length 28 ft. 10 in.

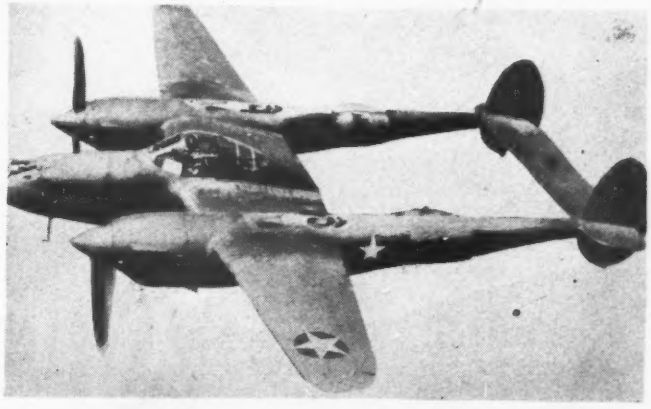


Rudy Arnold

Lockheed P-38 *Lightning*

Of unique twin-boom construction, the single-place P-38 has proved to be an unusually versatile craft, serving as a high altitude fighter, low-level and dive-bomber and photograph-reconnaissance plane. It is powered by two turbo-supercharged 1150 hp. Allison liquid-cooled engines giving it a ceiling of over 40,000 ft. and a top speed of "well over 400 mph." A special Lockheed-Fowler flap, however, keeps landing speed down to 80 mph. and aids maneuverability. Span is 52 ft., length, 37 ft. 9-15/16 in., height, 9 ft. 9⅝ in. and gross weight 13,500 lb.





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MAKE THEM MORE & MORE AUTOMATIC!
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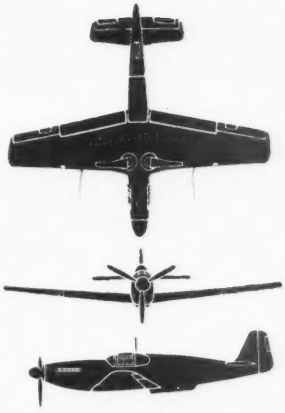
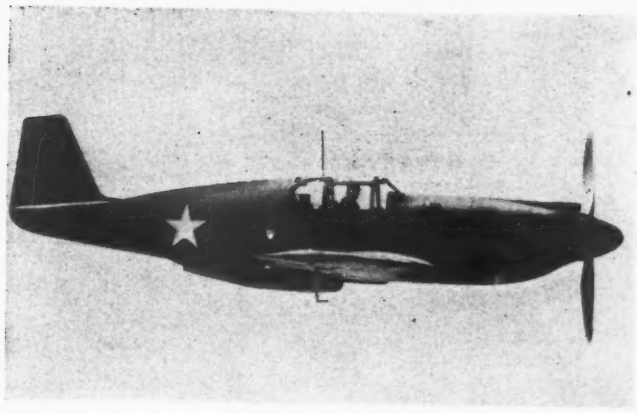
North American P-51 *Apache*

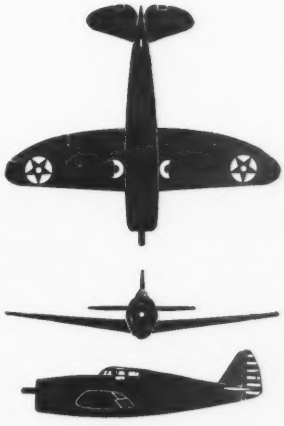
Called one of the most aerodynamically advanced aircraft in operation today, the P-51 is one of the few single-engine fighters used over Germany itself, an indication of its long-range on which actual data, with speed and armament, are restricted. In service with the RAF as the *Mustang*, it is also used extensively as an Army cooperation plane on daylight sweeps over France, on offensive operations against Nazi transport and communications. Powered by an 1150 hp. Allison, the P-51 weighs 7,724 lb., has span of 37 ft., length of 32 ft. 2 in.





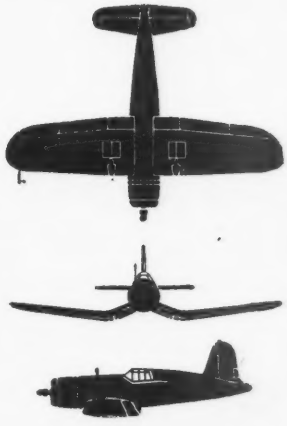
Republic P-47 *Thunderbolt*

The largest and heaviest single-place fighter in the world. It is a low-wing monoplane of 41-ft. span, 32-ft. 8 in. length. One Pratt and Whitney 2000 hp. turbo-supercharged engine takes this plane to high altitudes and gives it a top speed of more than 400 mph. Armed with at least six heavy calibre machine guns, it is unequalled in firepower. It was designed by Alexander Kartveli. Weighing more than 13,000 lb., it is as heavy as the old Ford tri-motor. A large four-blade propeller harnesses the horsepower.



Vought F4U *Corsair*

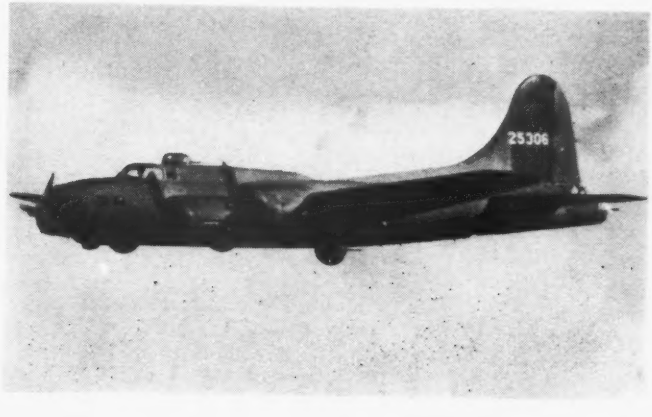
The world's fastest shipboard fighter. Span, 40 ft., length, 31 ft. With a Pratt and Whitney 2000 hp. engine, it is the Navy's most powerful fighter, in the 400 mph. class. It has many heavy calibre machine guns, and is comparable in many ways to the P-47, weighing a little over 9,000 lb. loaded. The inverted gull wing shortens the landing gear and still gives necessary clearance for large propeller, and improves the pilot's visibility as well.



Bombers

Boeing B-17E *Flying Fortress*

The ship that changed European concepts of precision bombing. Heavily armored, with exceptional fire-power, it has 13 guns of various calibres. Powered by four 14-cyl. 1200 hp. Wright *Cyclones*. Gross weight, about 30 tons. Span, 103 ft. 9 in., length, 73 ft., height, 15 ft. 6 in. This plane is also being built in quantity by Douglas and Vega, in one of the earliest examples of industry cooperation.



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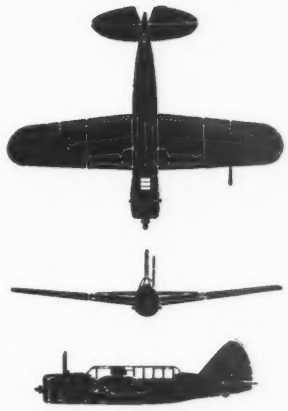
A fuller description of our facilities is contained a recently published magazine article, a reprint which we'll gladly send to you upon request.

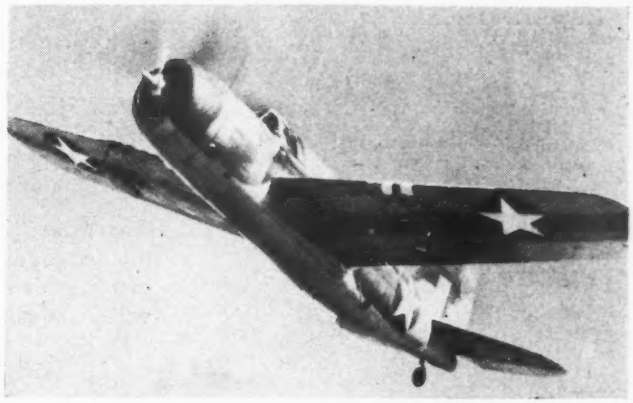
TURN IN THAT SCRAP...TO BEAT THE JAP

RAMCO MICRO-LAP *Aircraft Piston Rings*

Brewster SB2A *Buccaneer*

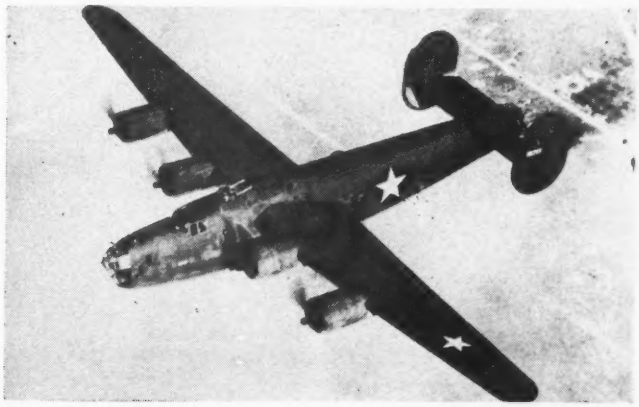
An all-metal, mid-wing monoplane shipboard fighter-bomber. The British export version, *Bermuda*, is used as a land-based plane. Driven by a two-row Wright *Cyclone* 1650 hp. engine, top speed is about 350 mph. Range, 1000 mi. Span, 47 ft., length 39 ft. 6 in. Weight loaded, 11,000 lb. Both pilot and gunner are protected by armor. It is provided with split "swiss cheese" type diving flaps similar to those installed on the Douglas *Dauntless*.





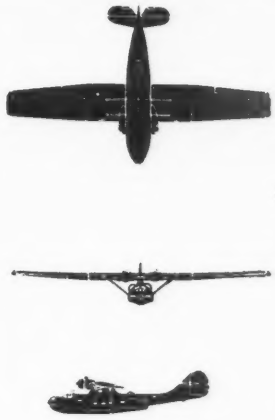
Consolidated B-24 *Liberator*

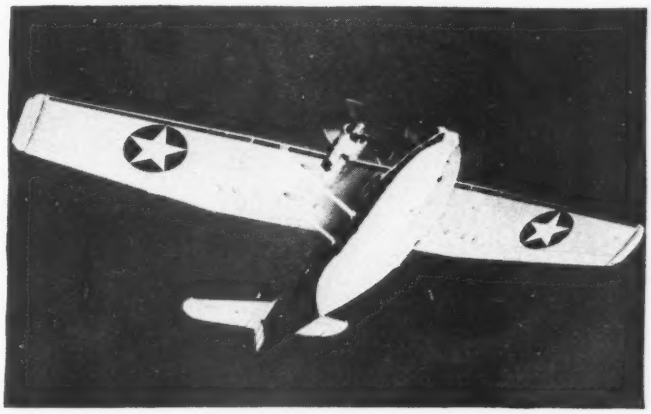
Long-range heavy bomber with a span of 110 ft., length, 64 ft. High wing type, with twin-fin and rudder. Four Pratt & Whitney 1200 hp. engines give a speed over 300 mph., and a range of over 3,000 mi. Loaded weight, about 60,000 lb. Bomb load, about four tons. Conforming to American practice, it is heavily armed to cover every possible angle of attack. It has the narrow chord of the Davis wing which makes the craft easy to identify. A cargo version, the C-87 *Liberator Express*, is also in mass production.



Consolidated PBY-5 *Catalina*

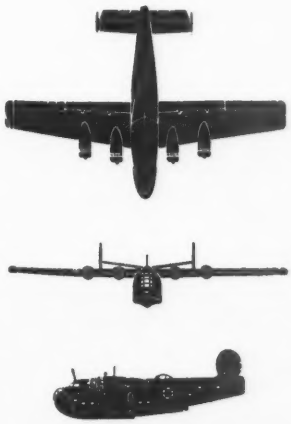
An outstanding long-range patrol bomber with a span of 104 ft., length, 65 ft. With two Pratt and Whitney 1200 hp. twin-row radials, it has a top speed of 185 mph. and a range of 3,000 mi. Weight loaded, 27,080 lb. Armed with machine guns in nose, side blisters, and tunnel hatch. Depth charges or torpedoes, or bombs may be carried under the wings. Extensively used by the British as well as ourselves. It was a *Catalina* which found and trailed the Nazi battleship *Bismarck*.

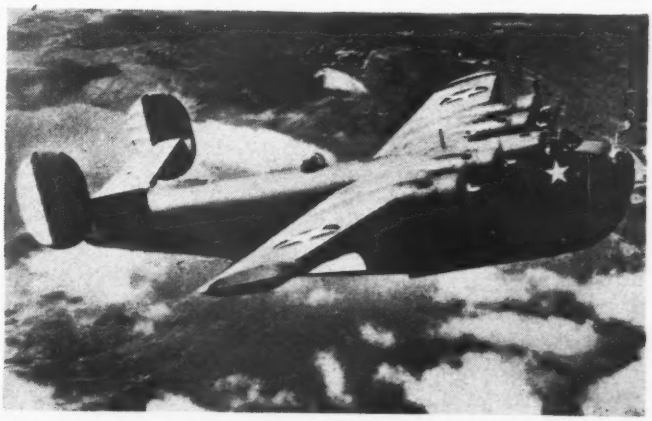


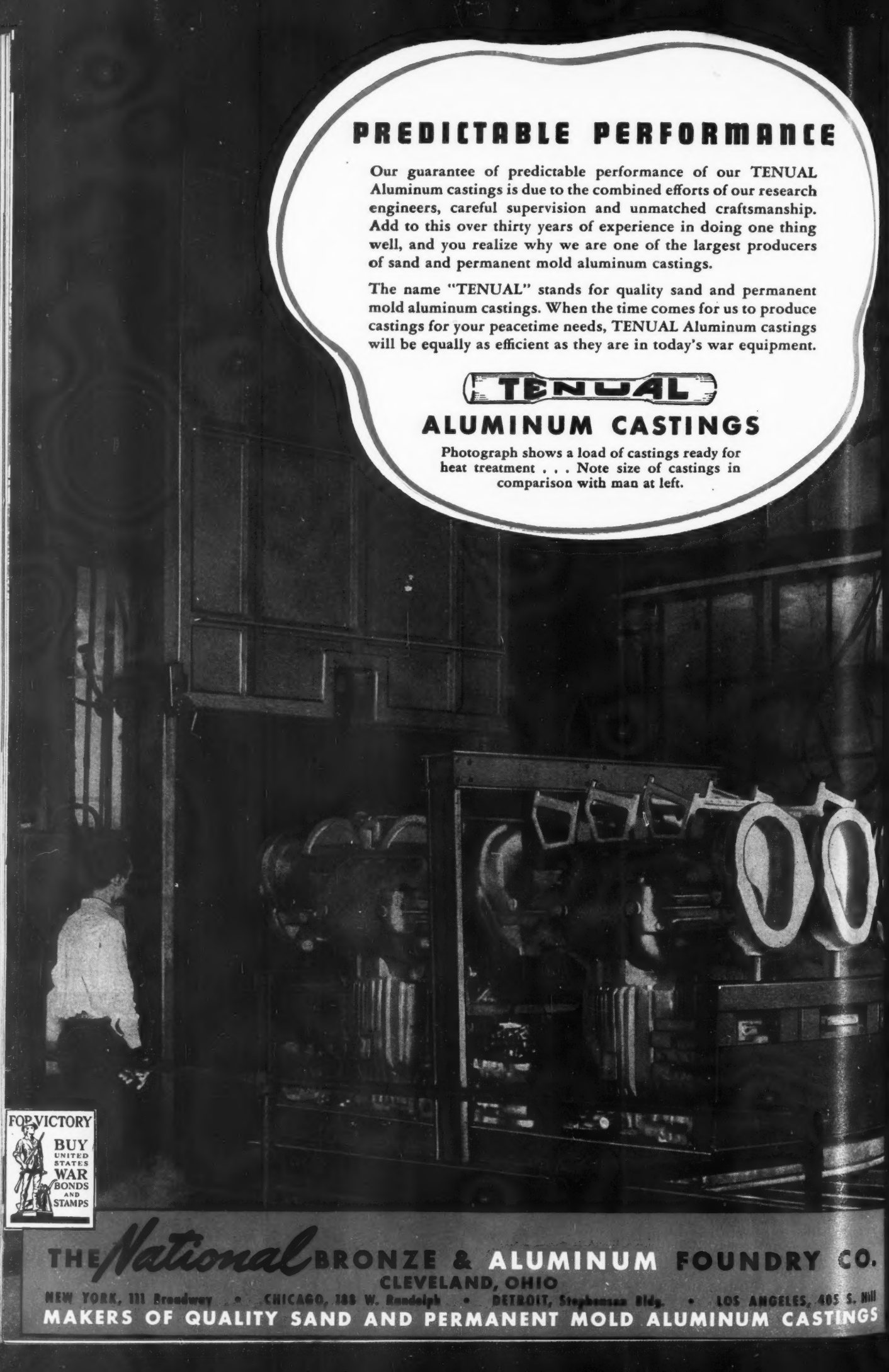


Consolidated PB2Y *Coronado*

This four-engine patrol bomber flying boat is credited with a range of nearly 5,000 mi. Like its sister ship, the Consolidated PBY *Catalina*, it has retractable wing floats which fold out and up to form the wingtips. The largest airplane in naval service, it is 25 ft. high, 115 ft. in span, 79 ft. 4 in. in length and has a gross weight of 60,000 lb. Powered by four 1200 hp. Pratt & Whitney engines, it has a top speed of approximately 225 mph. Armament consists of heavy caliber machine guns.







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Our guarantee of predictable performance of our TENUAL Aluminum castings is due to the combined efforts of our research engineers, careful supervision and unmatched craftsmanship. Add to this over thirty years of experience in doing one thing well, and you realize why we are one of the largest producers of sand and permanent mold aluminum castings.

The name "TENUAL" stands for quality sand and permanent mold aluminum castings. When the time comes for us to produce castings for your peacetime needs, TENUAL Aluminum castings will be equally as efficient as they are in today's war equipment.

TENUAL

ALUMINUM CASTINGS

Photograph shows a load of castings ready for heat treatment . . . Note size of castings in comparison with man at left.

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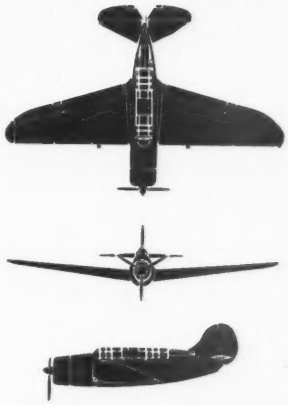
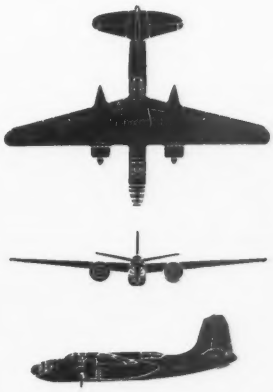
Curtiss SB2C *Hell Diver*

A heavy shipboard fighter-bomber, used by the Army under the designation A-25. Low mid-wing monoplane. Engine, one Wright *Cyclone* 1700 hp. two-row radial. Top speed, 300 mph. Range of 1,200 mi., cruising speed of 250 mph. Service ceiling, 25,000 ft. Span, 49 ft. 8 in., length 35 ft. 2 in. Armament details restricted, but it is rated as one of the most heavily armed ships of its type in the world. A bomb load of about 1,800 lb. bombs can be carried inside the fuselage.



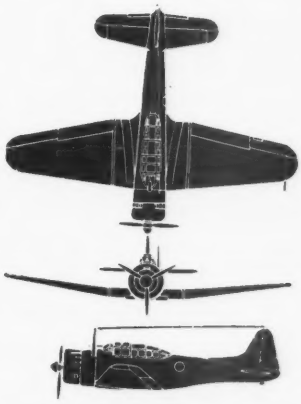
Douglas A-20 *Boston*

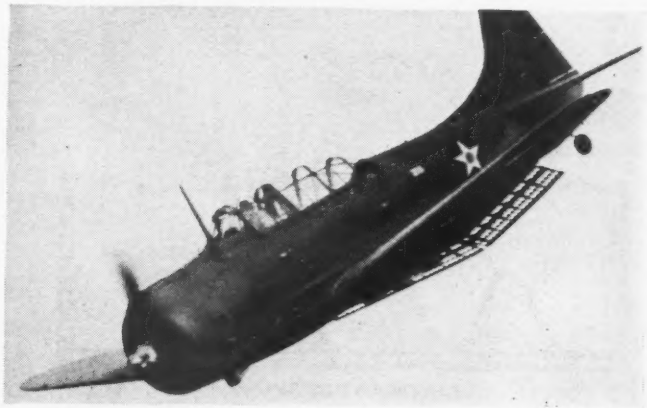
This very versatile attack-bomber is used by the British as the *Boston* for a wide variety of straight-and-dive bombing. As the *Havoc*, carrying heavier armament, it has proved to be one of the world's most deadly night fighters, used with great effect by the RAF over England. Span, 61 ft. 4 in., length, 47 ft. 3 in. Engines, two Wright *Cyclone* 1,700 hp. radials. Top speed, over 325 mph. Employs tricycle landing gear. In desert fighting with its attendant maintenance problems, the A-20 has an impressive record.



Douglas SBD *Dauntless*

Also in service with the Army as the A-24 *Banshee*, this dive bomber has seen plenty of action in naval engagements, including the Coral Sea and Midway Battles. An unusual feature is the "swiss cheese" type perforated flap, one half of which folds up and the other down to act as a diving brake. A 500-lb. bomb is carried externally under the fuselage and light bombs can be slung under the wings. Its 1,000 hp. Wright *Cyclone* engine gives a top speed of 275 mph. Span is 41 ft. 6 in., length, 31 ft. 8¾ in., height, 13 ft. 1 in.

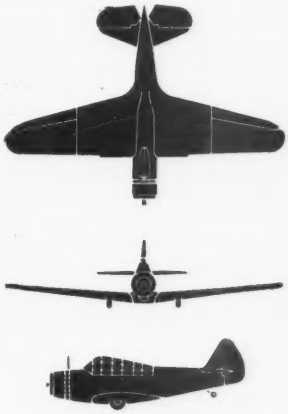


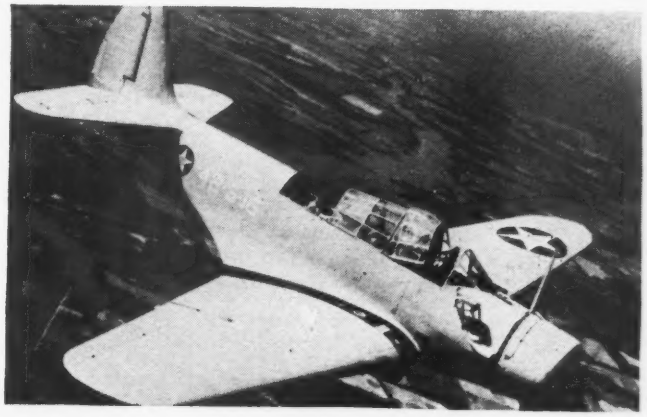


Rudy Arnold

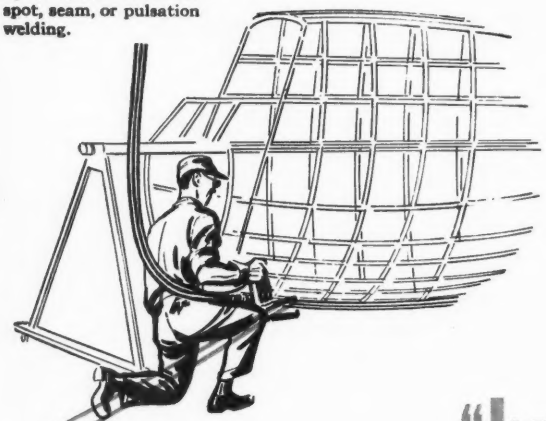
Douglas TBD *Devastator*

Developed from one of the first monoplane torpedo bombers, it is one of the standard carrier-borne craft of this type. Though not so widely publicized as others of its type, it served with honor in the Battle of Midway and other engagements. The wing skin is corrugated from the landing gear—which retracts rearward—to the tips. Weighing 9,300 lb. with full load and crew of three, it has a span of 50 ft., length, 35 ft. 6 in., and height of 18 ft. 1 in. An 825 hp. Pratt & Whitney *Twin Wasp Junior* engine gives it a top speed of 225 mph. at 9,000 ft.





Timer illustrated is a Type SX Combination Synchronous Timer for spot, seam, or pulsation welding.



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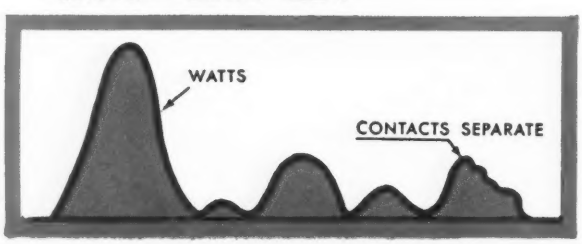
Where welding time of a few cycles only is required for critical metals and small parts, random (nonsynchronous) switching seriously affects the quality of the weld. This is because initial surge currents can cause as much as 50% variation in the heat produced in a weld—producing either a warped, burned, or weak, cold weld.

Westinghouse Synchronous Timers eliminate unpredictable "transients" or current surges by always starting and stopping the weld current at the zero point on the current wave, or later (when heat control is used). As a result, each weld duplicates the quality of the preceding one because the wave form is the same.

These timers make possible a rigorous system of quality control that insures consistent welding of critical alloys and thin materials. Stainless steel, for example, can be welded without loss of stainless properties. Discoloration and electrode "pick-up" can be reduced. Investigate the possibilities of Westinghouse Electronic Control for your resistance welders. Ask your Westinghouse Representative for Booklet B-3102. Or write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-21223

SYNCHRONOUS TIMING
Starting and stopping at zero point produce even wave form—uniform "heat".



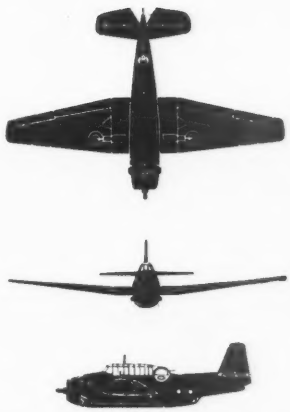
NONSYNCHRONOUS TIMING
Random (nonsynchronous) switching may produce this wave form—unpredictable "heat".

Westinghouse

RESISTANCE WELDING CONTROL

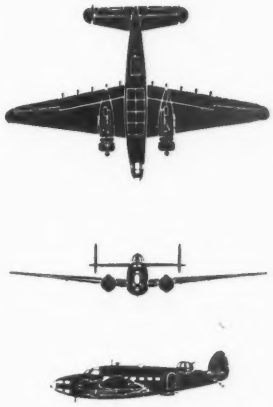
Grumman TBF *Avenger*

The Navy's famous new torpedo bomber. Very similar to the *Wildcat* in appearance, it can carry a full size torpedo internally, and is one of the largest carrier-borne aircraft. Approximate dimensions are: Span, 53 ft., length, 37 ft. Gross weight, 12,000 lb. Engine is one Wright *Cyclone*, 1700 hp. radial. Top speed is said to be about 270 mph. Carries a crew of three, with a dorsal turret, a tunnel gun bottom rear, and 2,000 lb. of bombs, or a torpedo. The range is probably upwards of 1,200 mi.



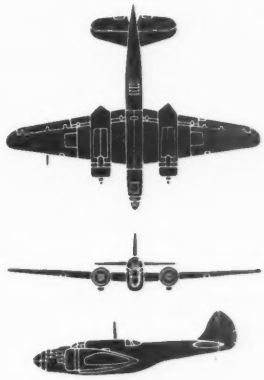
Lockheed A-29 *Hudson*

A medium patrol bomber, also in service with the Navy as the PBO. Low mid-wing, twin-tail. Span, 65 ft. 6 in., length, 44 ft. 6 in. Engines, two 1200 hp. Wright *Cyclone* radials. Top speed, about 300 mph. Range, 2,000 mi. or over. Armed with guns in the nose, and a spherical power turret top rear. With the Douglas *Boston*, this was the first of our bombers to serve abroad, and more *Hudsons* have flown the Atlantic than all other makes combined. Without warpaint it is the AT-18 for training and gunnery.



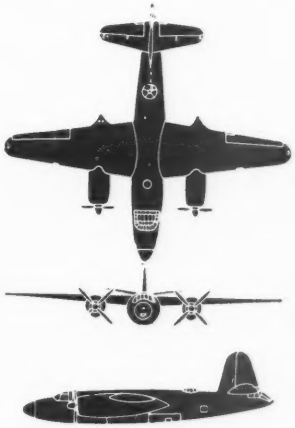
Martin A-30 *Baltimore*

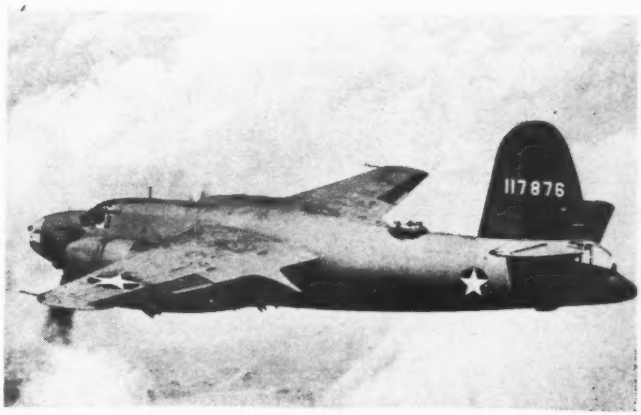
Developed from the A-22 *Maryland*, the *Baltimore* has been used extensively by the British, particularly in the Mediterranean theatre, where it has established a record of being an especially fast, hard hitting medium bomber. An outstanding structural difference from its predecessor is that dorsal, as well as ventral, guns can be installed. It is powered by two 1700 hp. Wright *Cyclone* engines. Span is 61 ft. 4 in., length, 45 ft. 1 in. and height, 17 ft. 9 in. Performance data are restricted, but the plane undoubtedly exceeds the A-22's 304 mph. high speed.



Martin B-26 *Marauder*

A high-wing, single-tail, medium bomber, powered by two Pratt and Whitney 1850 hp. *Twin Wasps*. Speed well over 300 mph. and range over 1,300 mi. This ship carries nearly the load of a heavy bomber at pursuit-plane speed. With the fleet at Midway, and in the Aleutians, it was used as a land-based torpedo bomber with devastating effect. With heavy guns in nose, top-turret, and tail, it can out-shoot many pursuit planes; the Japs "seldom outrun it, never outgun it." Span, 65 ft., length, 58 ft. 3 in.





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Just one example of the varied aircraft duties OSTUCO seamless tubing is performing at present.

ARMY P-39 AIRACOBRA
Photos Courtesy Bell Aircraft Corporation

Aircraft Performance Protected by OSTUCO at Many Vital Points

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From production for war plane parts, OSTUCO is constantly gaining new skills and experience for manufacture of seamless tubing. This experience covers new steels and alloys, a wide variety of gauges, shapes, lengths and finishes, and strict specifications as to hardness, O.D. and I.D. diameters, ductility and machinability.

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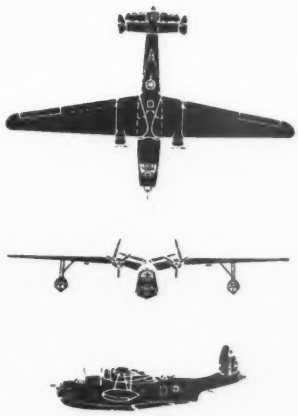
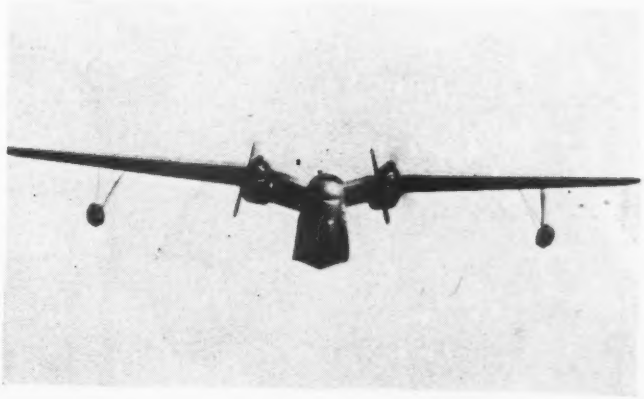
Martin PBM-3 *Mariner*

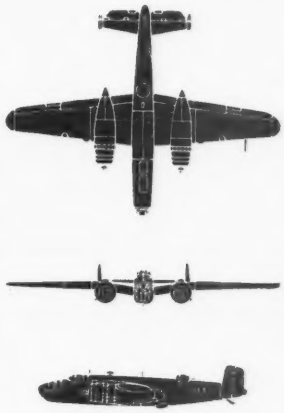
The Glenn L. Martin Co. is delivering both long-range patrol bomber and cargo versions of the PBM-3, which differs from its predecessor principally in the fact that it has fixed rather than retracting wing floats. As a patrol bomber the *Mariner* mounts guns forward, aft and on both sides, and carries a crew numbering up to twelve. Gross weight is 40,000 lb. It is powered by two 1750 hp. Wright *Cyclone* engines turning Curtiss electric constant-speed propellers of 15 ft. diameter. Span is 118 ft., length is 80 ft. and height is 27 ft. 6 in.





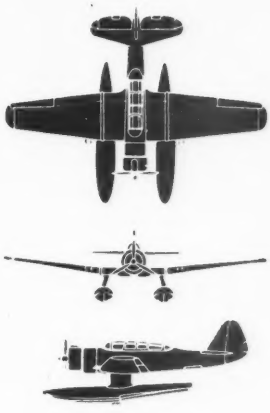
North American B-25 *Mitchell*

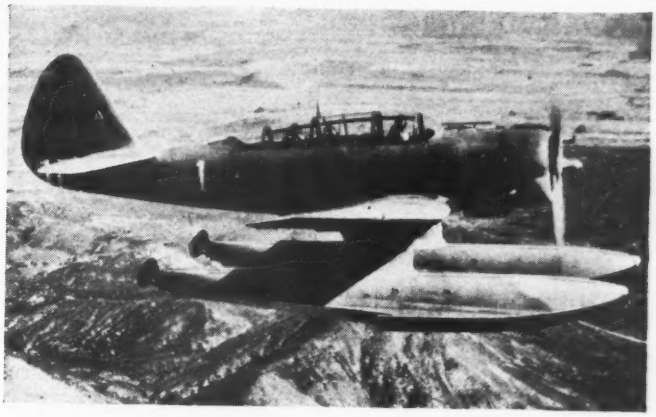
A fast, mid-wing monoplane medium bomber, with twin tails, carrying a crew of five. With two Wright *Cyclones* of 1700 hp., this plane has a top speed of approximately 300 mph. Heavy calibre machine guns in the nose, dorsal and ventral turrets make this ship a formidable opponent. Maj. Gen. Jimmy Doolittle took a flight of these over Tokyo, from where only the inhabitants of Shangri La know, and they won't tell. Also widely used in Africa for road bombing and strafing. Span is 67 ft. 6 in., length, 51 ft. 5 in.



Northrup N-3PB

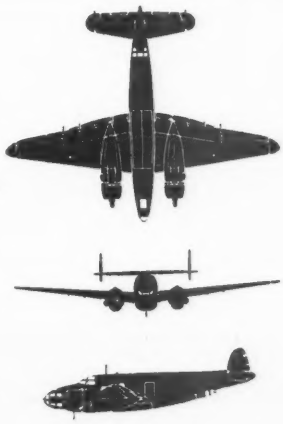
A low-wing, twin-float, three-place patrol bomber. Span, 48 ft. 11 in., length, 36 ft. Designed for operation against surface craft. Engine, one Wright *Cyclone* delivering 1100 hp. at take-off. Top speed is 257 mph., cruising speed, 217 mph. Service ceiling, 24,000 ft. Maximum weight, 10,600 lb. Bomb load, 2,000 lb., or one torpedo of this weight. Armed with four 50-cal. machine guns in wings, one flexible 30-cal. or larger upper rear and one 30-cal. or larger for bottom rear. Range, about 1,000 mi.





Vega B-34 *Ventura*

A medium bomber version of the Lockheed *Lodestar* transport, the *Ventura*, was put into service by the RAF on destructive daylight forays over Nazi-held territory before the fact that it was in production had been revealed. The first planes to go into action were, of course, flown from the factory to their English bases. The B-34 is powered by two 2000 hp. Pratt & Whitney *Double Wasps*, but performance figures are restricted. It carries a crew of four, has a span of 65 ft. 6 in., length of 57 ft. 6 in., and twin-tail with a span of 25 ft. 10 in.



Aero Tool's Automatic Bucker Cuts Labor Costs One-Half, Rivets Better in Less Time, and replaces an operator for other work. Now one tool, the Aero Tool Automatic Bucker, simultaneously bucks and rivets in one operation, by one operator. Tested, proved, and now in use in a leading West Coast aircraft plant, Aero Tool Automatic Buckers are now available for plants throughout America, to further speed our war production.

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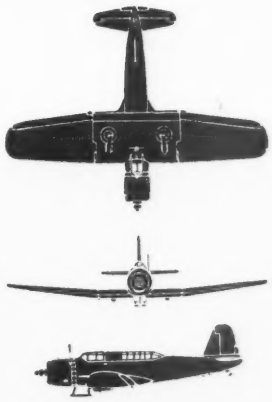
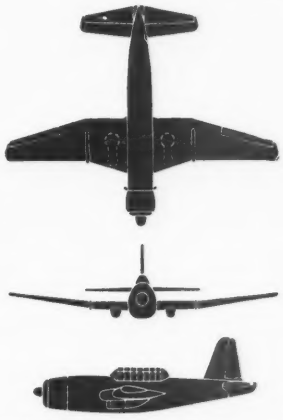
Vought Sikorsky SB2U-3 *Vindicator*

This carrier-based dive-bomber is called the *Chesapeake* by the RAF. Powered by an 850 hp. Pratt & Whitney *Twin Wasp Junior*, the *Vindicator* has a top speed of more than 250 mph. and carries a bomb load of 1,000 lb. Its cruising range is approximately 700 mi. Fuselage is all-metal to just aft of the wing's trailing edge; from there back it is of fabric-covered tubular construction. Carrying a crew of two, it mounts four machine guns fixed in the wing and has one flexible gun for the rear cockpit. Span, 42 ft., length, 33 ft. 11⅝ in., height, 9 ft. 9 in.



Vultee A-31 *Vengeance*

A two-place dive-and attack-bomber of 48-ft. span, and 40-ft. length. Engine is one Wright *Cyclone* 1700 hp., radial. Said to be unusually stable in dives. Range is about 1,200 mi. Armament details are restricted. This ship was ordered by the British early in 1940, and large numbers were exported. They are also in use with our Navy, under the designation TBV.



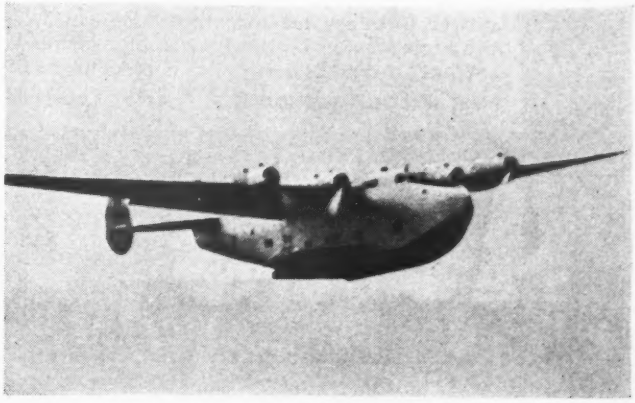
Cargo Transport

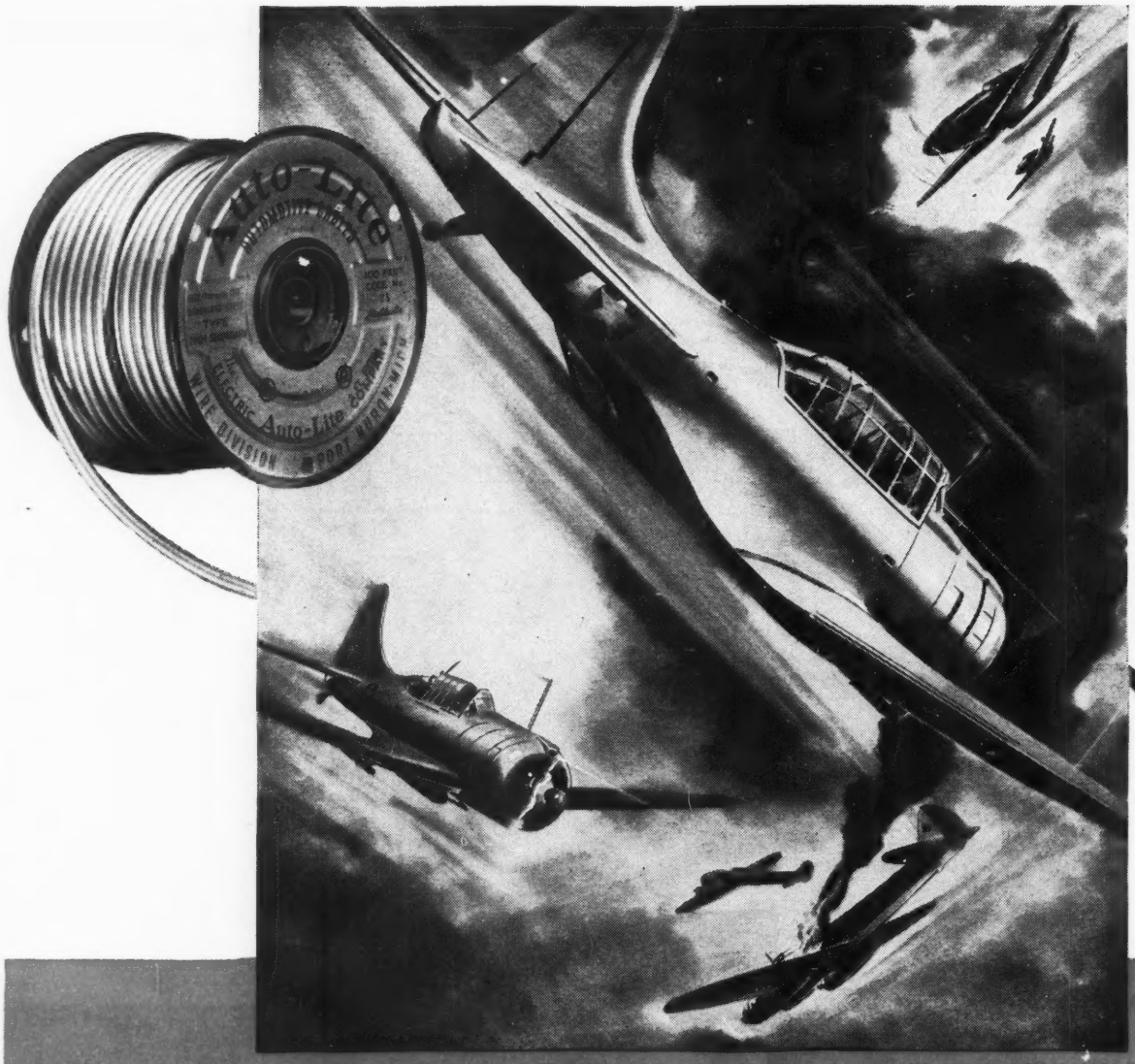
Boeing 307 *Stratoliner*

This is the *Stratoliner* gone to war. Low-wing, four-engine, supercharged transport. Span, 107 ft. 3 in., length, 74 ft. 4 in., height, 20 ft. 9 in. Gross weight, 45,000 lb. Engines, four Wright *Cyclone* 1100 hp. Top speed, 250 mph. at 16,200 ft., cruising speed 222 mph. at 19,000 ft. Range 1,675 mi. Service ceiling, 24,400 ft. Rate of climb at sea level, 1,200 ft. per min. Like many another product, this luxury-liner of peace-time is giving stalwart service carrying much needed supplies to the armed forces.

Boeing 314 *Clipper*

The world-famous *Clipper*, still used commercially by the U.S. and British now serving, in addition, the armed forces. Span, 152 ft., length, 106 ft., height, 20 ft. 9 in. Powered by four Wright *Cyclone* 1600 hp. engines. High speed, 210 mph., cruising speed, 188 mph., range, 4,900 mi. Hull, heavy Alclad sheets over aluminum alloy bulkheads and stringers. Gross weight, 84,000 lb. These ships of the air have spanned every ocean, and served all the besieged continents we are fighting to save.





War birds with Nerves of steel

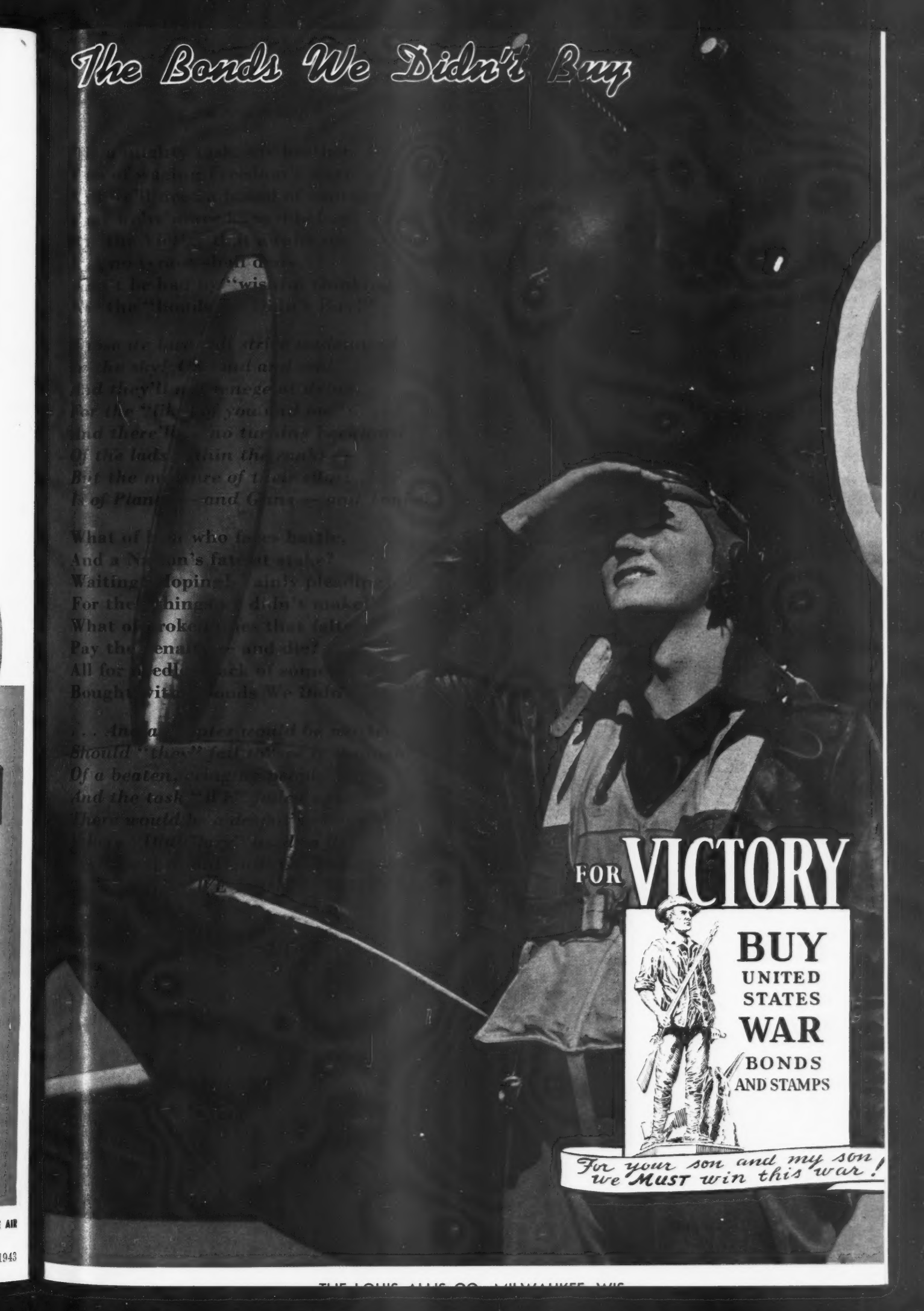
YOU'LL hear men talk about the nerve it takes to fly a modern plane. Planes so fast they match a bullet's speed; stresses so great that pilots lose consciousness as they level off from power dives. It does take nerve... human nerves... and more. For these planes have nerves as well, a rugged system of wires which provide for ignition, power, lighting and instrument application. For the high tension ignition wires in this "nervous system" Auto-Lite supplies Steelductor Cable.

For the low-tension requirements, Auto-Lite engineers have developed a group of cables that meet every phase of Army-Navy specifications and give a valuable "plus"—greatly increased resistance to abrasion. This superior operation can be expected from all of the various types of wire and cable manufactured by Auto-Lite... built by men who know, *and have met,* the exacting requirements of modern aviation. Write for Form No. 666 covering Steelductor Cable and Form No. 838 on Low-Tension Cable.

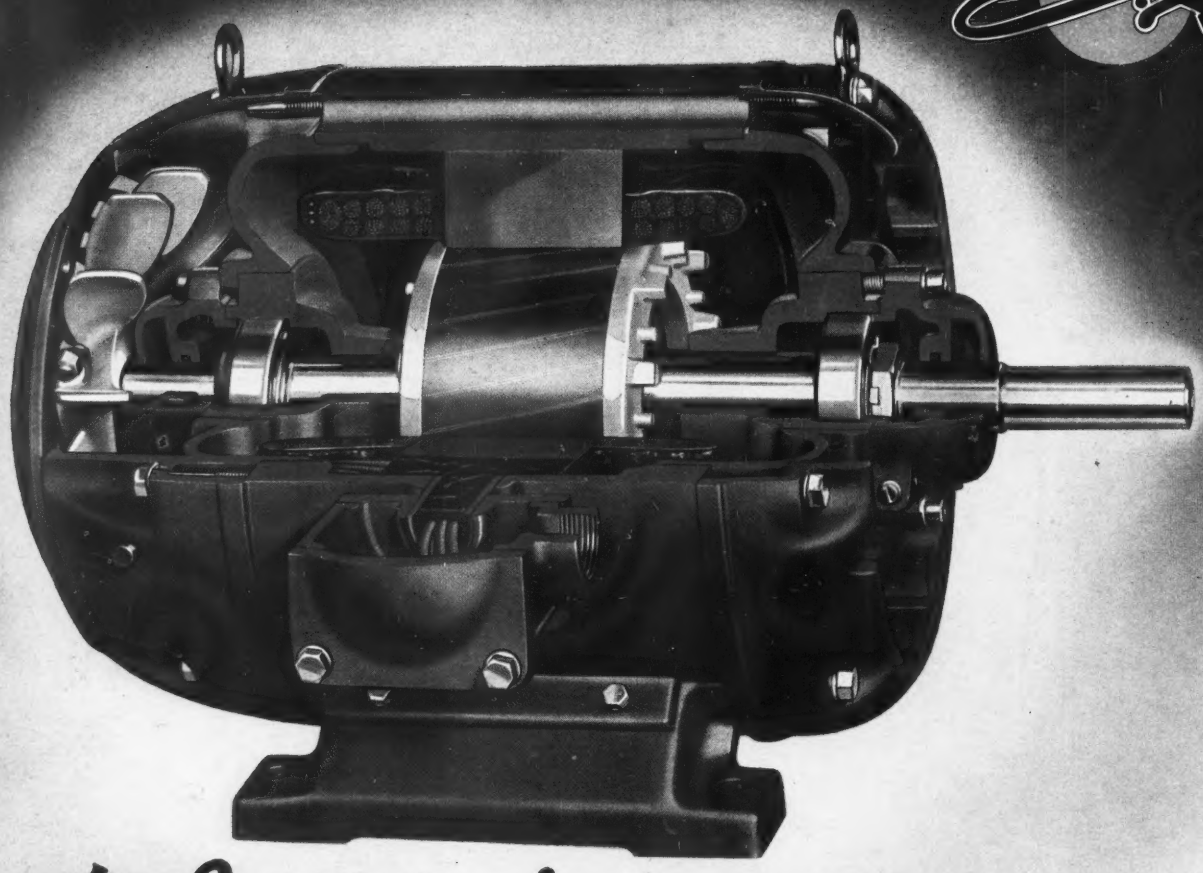
PORT HURON, MICHIGAN **THE ELECTRIC AUTO-LITE COMPANY** SARNIA, ONTARIO
Wire Division

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR


The Bonds We Didn't Buy
FOR VICTORY
BUY
UNITED
STATES
WAR
BONDS
AND STAMPS
For your son and my son
we MUST win this war!

LOUIS ALLIS



Look Inside!

The Louis Allis EXPLOSION-PROOF motor is built to withstand the force of the greatest explosion possible within its heavy iron walls—with a safety factor of *five*!

With a safety factor of FIVE—the Louis Allis Explosion-Proof has twenty carefully designed specific features—features that make available a new high in electric motor efficiency, dependability, convenience and—SAFETY!

We have prepared a sixteen page booklet which completely illustrates and describes all of these important features—write for your copy—ask for Bulletin No. 508-E.

LOOK INSIDE—compare Louis Allis Explosion-Proof motor point by point with any others on the market—and we are sure you will agree that—here is the finest explosion-proof motor ever built—bar none!

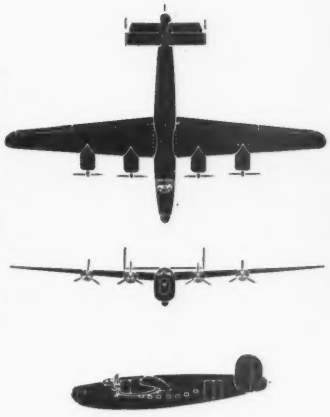
Specify your next explosion-proof motor by name—LOUIS ALLIS—you will be assured of the most complete protection and dependable performance available.

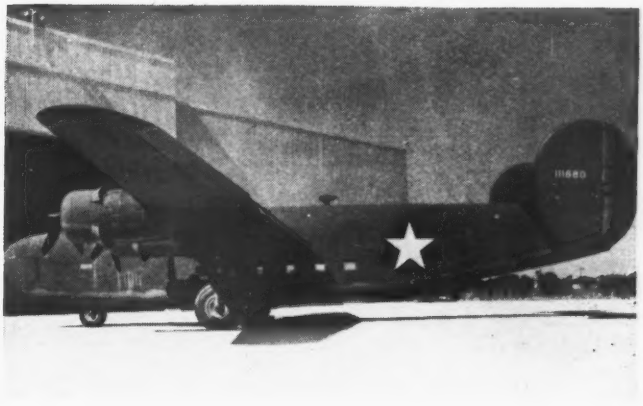
THE LOUIS ALLIS CO., MILWAUKEE, WIS.

BUY WAR BONDS—BUY THEM REGULARLY

Consolidated C-87 *Liberator Express*

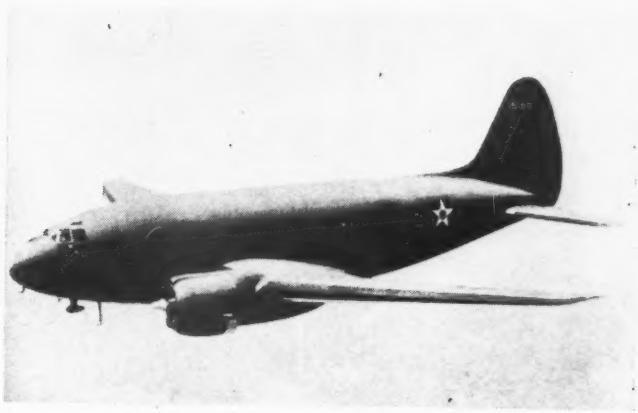
Cargo-transport version of the famed B-24 *Liberator* bomber, the C-87 "will carry the greatest human- or cargo-load of any airplane now in mass production—a cargo in excess of six tons." Wendell Willkie made his round-the-world trip and Prime Minister Churchill flew to Moscow, the Near East and to Casa Blanca in C-87's. Powered by four 1200 hp. Pratt & Whitney engines, it has a top speed of more than 300 mph. and a full-load range of over 3,000 mi. Span is 110 ft., length 63 ft., and height is 19 ft.





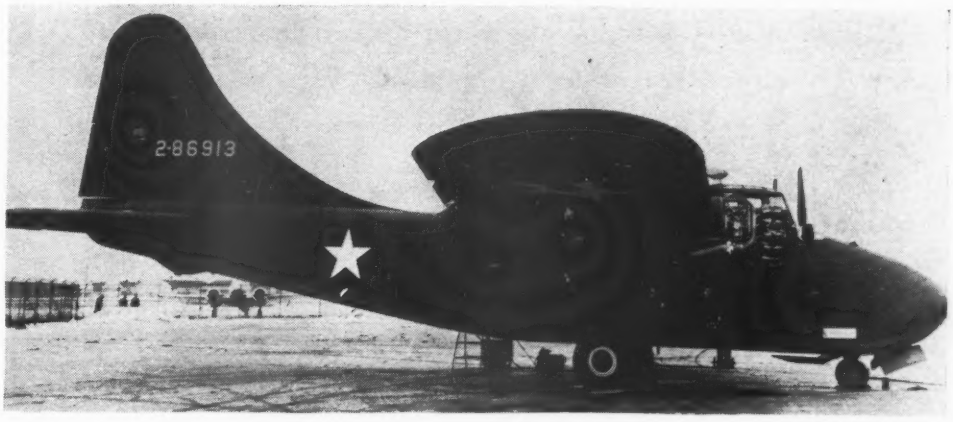
Curtiss C-46 *Commando*

A new military transport, the world's largest twin-engine airliner. Wing span, 108 ft., length, 76 ft. 4 in. Loaded weight, 50,000 lb. Powered by two Wright *Cyclones* of 2000 hp. each. This "troopship of the sky" can carry paratroops, ground forces, and mobile units, such as scout cars or artillery to distant points. Details on load and performance are restricted. Ships of this type are likely to be important commercial vehicles after the war.



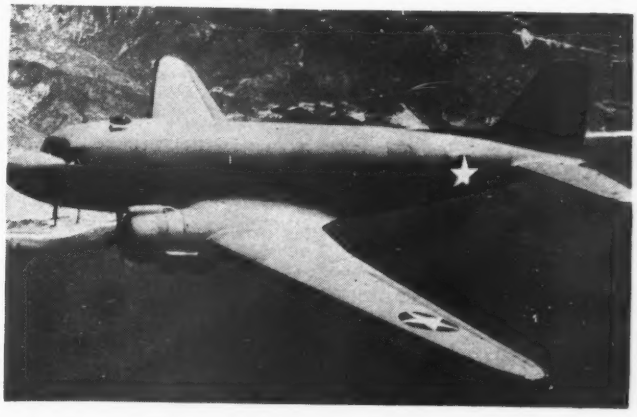
Curtiss C-76 *Caravan*

The first military transport designed in this war. Basically all-wood construction. With 65 percent of production subcontracted to the wood industry, its construction has a minimum effect on other aircraft production. Span, 108 ft., length, 68 ft. Engines, two 1200 hp. radial. Low landing and stalling speeds make it well suited for regions with small fields, and little means for repair of metal planes. Short take-off permits large overloads when used from large airports. Cargo floor is low for ease in loading.



Douglas C-47 *Skytrain*

Called the *Skytrain* by the Army, this is the DC-3 in warpaint. Span, 95 ft., length, 64 ft. 6 in., height, 16 ft. 11 in. Gross weight, 26,000 lb. Engines, Wright or Pratt and Whitney. Top speed, 220 mph., cruising speed 194 mph. Rate of climb, 1,050 ft. per min. At the start of the war, some 100 of these ships out of the country's 375 were put into immediate Army service, and they are still being produced in large quantities for the extensive transport needs of our widespread supply routes.



BONNEY TOOLS

More than 4200 Combinations Possible

With these standard 3/8" drive BONNEY Sockets and Attachments

A complete set of slim, sturdy Bonney 3/8" drive sockets and attachments makes it possible for you to reach practically any bolt or nut, no matter how inaccessible.

The more than 4200 combinations possible with them—each a separate and different tool—makes them particularly adapted to aircraft engine equipment and for production and service work.

Light weight, long, slender handles, thin wall sockets for work where clearances are limited—plus the strength found only in alloy steels of the highest quality have earned Bonney 3/8" drive Sockets and Attachments the reputation of "The Finest that Money Can Buy". Sockets are available with openings from 5/16" to 7/8".

The big 104 page Bonney Catalog will give you the complete list of sizes. Write for it if you have use for tools of this type.

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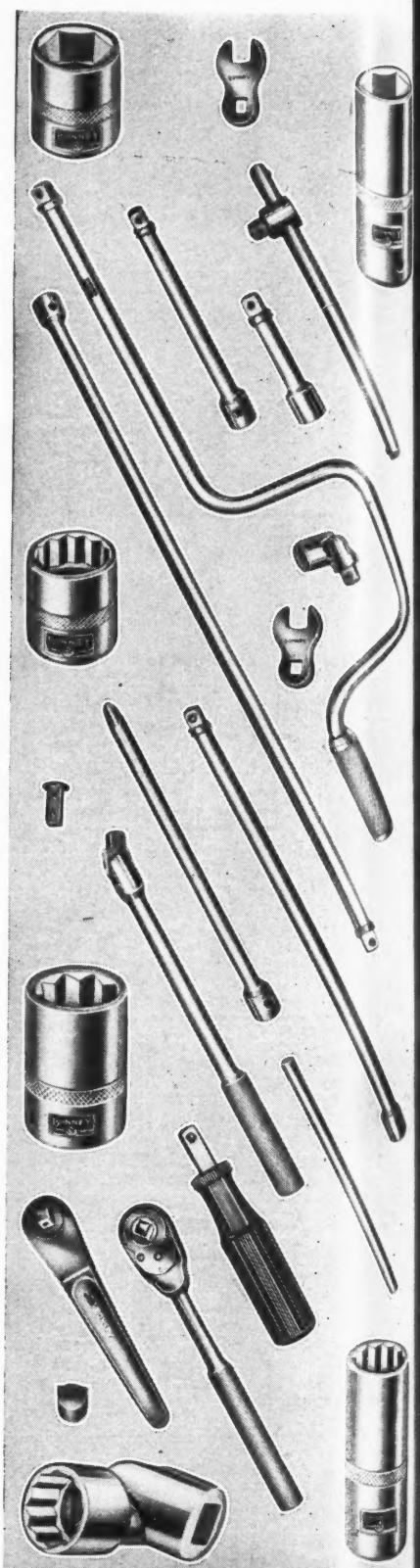


BONNEY

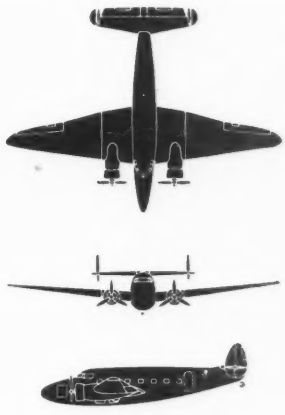
The Finest that Money Can Buy

Douglas C-54 *Skymaster*

Large transport, adapted to military use from the DC-4. Four Pratt and Whitney 1350 hp. twin-row radials give a top speed of mph., and a range of 2,540 at cruising speed of 240 mph. Service ceiling, 26,600 ft. Span 117 ft. 6 in., length, 94 ft. Weight, loaded, 52,000 lb. Although originally made with a triple tail, it is now a single-fin job. Paired landing wheels double traction for better braking. Cargo volume capacity is about equal to the standard box car.

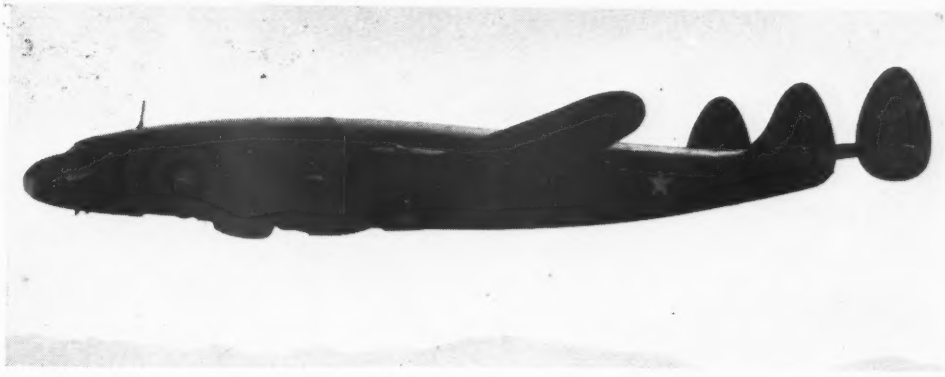
Lockheed C-60

The famous *Lodestar*, in Army transport service. Span, 65 ft. 6 in., length, 49 ft. 9 in., height, 11 ft. 10 in. Gross weight, 18,500 lb. Engines, either Pratt and Whitney or Wright *Cyclone* 1200 hp. Top speed, 265 mph. Will cruise at 230 mph. at 12,000 ft. using only 65 percent of total power. Takes off loaded in 17 sec. after a run of 930 ft. Initial rate of climb 1,600 ft. per min. This plane set a transport record of 2,357 mi. in 9 hr., 29 min. from Burbank, Calif., to Jacksonville, Fla.



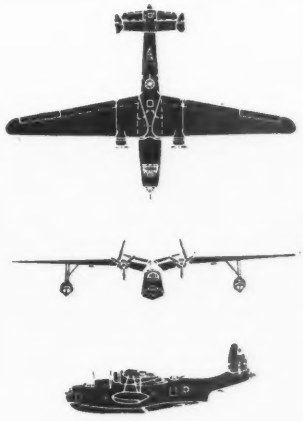
Lockheed C-69 *Constellation*

Lightiest of them all, the new high speed, long-range transport. Low-wing, triple-tail, four Wright *Cyclone* 18 cyl. 2000 hp. engines. Just being delivered to the Army, performance details are not revealed, but this ship "can cross the continent in less than 9 hr." Pressurized cabin keeps an air density of 8,000 ft. at levels of 20,000 to 35,000 ft., "well above the weather." Cruising speed at half power is 100 mph. faster than standard air-cargo speeds. Tricycle landing gear with front-wheel steering, and paired main wheels for better braking. Exceptional design permits a complete engine change in 45 min.



Martin PBM-3 Cargo *Mariner*

The importance of transport in global war is emphasized by the fact that some of the PBM-3's coming off the Martin production lines are being fitted as cargo-personnel transports. Dimensions, power and performance, therefore, are generally identical with the patrol-bomber version. The planes may be found in any theater of war, for they are operated both by the Navy itself and, more recently, have been put into service by American Export Airlines as trans-oceanic transports. Span of the cargo version is 118 ft., length is 80 ft., and height of the craft is 27 ft. 6 in.



CONQUISTADORES DEL CIELO

CONQUERORS OF THE SKY. These are the 20th Century warriors of Latin and South America... eager young men whose weapon is the airplane. Their's is a task worthy of a Simon Bolivar: train today, to teach tomorrow... so that the skies above *all the Americas* shall be forever free.

It is fitting that this nation should make vital training facilities available to our Good Neighbors, though now engaged in its greatest war.

It is appropriate, too, that many of the Inter-American students should be assigned to the Civilian Pilot Training Program at the Sky Harbor division of Southwest Airways. In our training of United States Army and Navy instructor personnel there... and Yank, English and Chinese military flyers at our other fields... we of the Thunderbird also are hastening the day when the skies above *all the world* shall be forever free.

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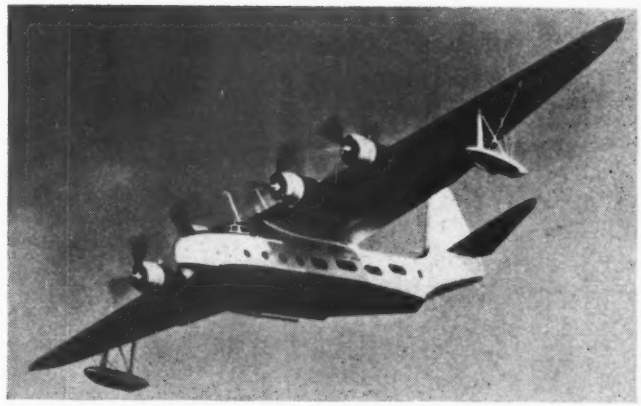
ught-Sikorsky VS-44A *Excalibur*

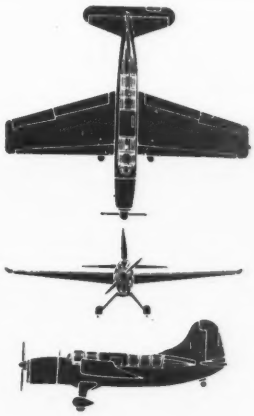
four-engine flying boat, slightly aller than the Boeing *Clipper*, has a span of 124 ft. and a gth of 79 ft. 3 in. Height is ft. 7 in. Gross weight, 57,500 Engines are four Pratt and hitney *Twin Wasps* of 1200 hp. p speed, **225 mph.** Cruises at mph. and has a range of 3,800 at 150 mph. Initial rate of mb. 900 ft. per min. This type s built for American Export es and put in transatlantic il and passenger service.

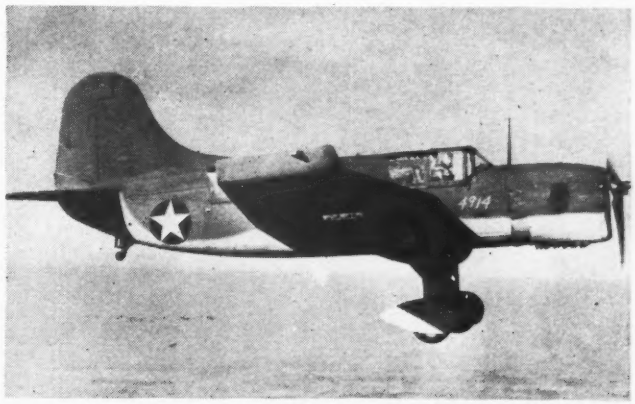


bservation

Curtiss S03C *Seagull*

test in a long line of Curtiss out-observation planes, the *Seaull* is designed to operate either a land-based craft or on floats, rving as "the eyes of the fleet" sea. Carrying a pilot and radio erator-observer, it is powered by 12-cyl. V-type aircooled Ranger gine. Cruising range, speed, ceil- and other performance data restricted. Indicative of the iation industry's cooperation to rease production, the same craft being built by Ryan Aeronautical . under the Navy designation OR-1.





ught-Sikorsky OS2U *Kingfisher*

two-place, low mid-wing mono- ne, built both as land plane and plane. Powered by a Pratt and hitney *Wasp Junior* 450 hp. gine. Top speed, over 175 mph., ising speed, **165 mph.**, service iling, 15,000 ft., range, about 00 mi. Weight loaded, 4,600 lb. pan, 36 ft., length, 33 ft. 10 in. as plane, 30 ft. 1 in. as landplane. was a *Kingfisher* which sighted pt. Rickenbacker and crew, and ied 40 miles back to base with o men lashed on the wings and squeezed in the cockpit.

Liaison-Trainers

Aeronca L-3 ←

A standard Aeronca design adapted to military liaison use. Two place, powered by a Continental 65 hp. engine. A transparent cabin enclosure gives the increased visibility needed for this job of "seeing for the Army."

Aeronca PT-23 →

A low-wing tandem trainer, two place, powered by a Continental 220 hp. radial engine. This is a larger and heavier plane than the Aeronca high-wing types, having a gross weight of 2658 lb. One of many to turn out more pilots.

Vital as Hell!

Hydraulic systems carry and control the life blood of today's fighting aircraft—they must not fail!

Dirt, moisture, or corrosion in lines or units—or *any* damage to threads or tapered surfaces of connecting links will cause failures.

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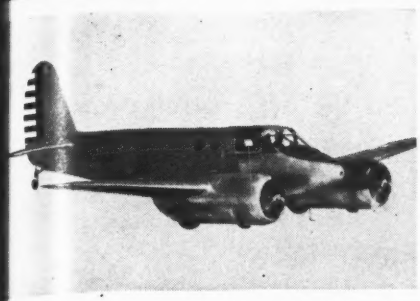
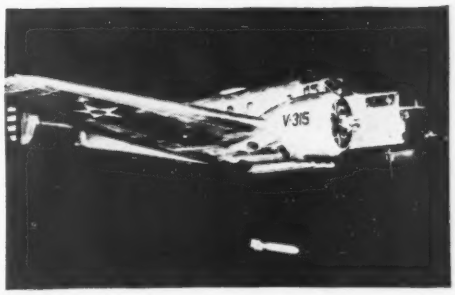


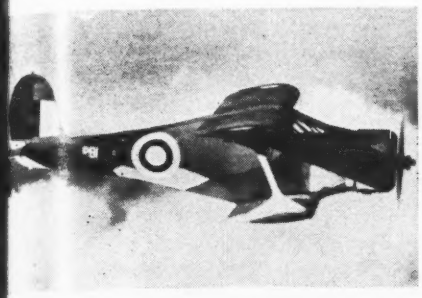
← **Beech AT-10 *Wichita***

A widely known transition trainer used for multi-engine instruction. To conserve strategic materials plywood is used in most of the plane. Two 280 hp. Lycoming engines give a top speed of 200 mph.

Beech AT-11 *Kansas* →

An all-metal twin-engine advanced trainer for specialized training of bombardiers and gunners. Engines are two Pratt and Whitney 450 hp. 9-cyl. radials. Equipped with flexible guns and bomb racks.



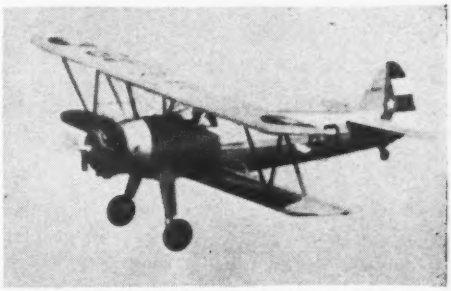


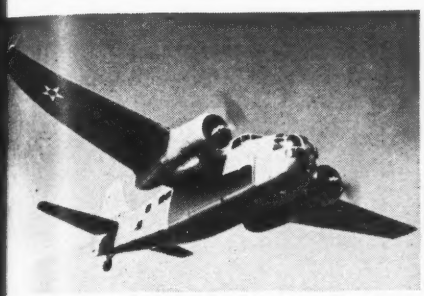
← **Beech C-43**

The famous Beech biplane used by the Army for personnel transport. Powered by one Pratt and Whitney 450 hp. 9-cyl. radial engine, with a top speed of 203 mph.

Boeing PT-17 →

Boeing's standard biplane primary trainer, used also by the Navy as the N2S3 *Caydet*. A very rugged plane designed to take abuse, and made readily accessible throughout for most rapid and least costly maintenance and repair.



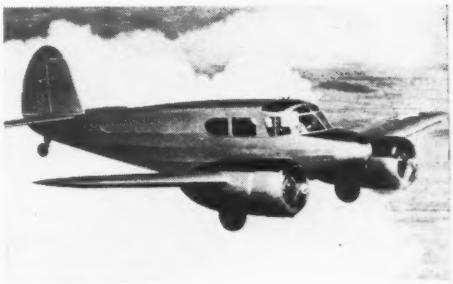


← **Boeing AT-15 *Crewmaker***

Twin-engine advanced trainer for instruction of bomber crews. Metal has been spared in construction with fabric covering, wood fairing, plywood supporting surfaces. Pratt and Whitney engines.

Cessna AT-17 *Bobcat* →

Another twin-engine advanced trainer, powered by two Jacobs 245 hp. radials. Available in large numbers, it has served Canada and England as the *Crane*.

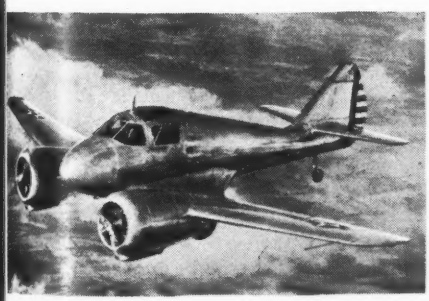


← **Commonwealth 190F**

Formerly the Rearwin, this is a two-place side-by-side craft widely used for private flying and flight training. Powered by a 90 hp. Franklin, it has a top speed of 121 mph. and cruises at 112.

Commonwealth 8135T →

A two-place version of the 8135 in service as an airline pilot instrument and navigation trainer. Powered by a 120 hp. Ken Royce.

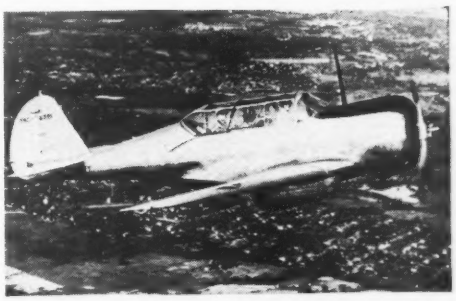


← **Curtiss AT-9 *Jeep***

An advanced training craft developed especially to give pilots transition training from single to multi-engine bomber types, the AT-9 has many "big ship" characteristics.

Curtiss SNC-1 *Falcon* →

A two-place advanced combat Navy training plane adapted to all types of naval training. Powered by a 450 hp. Wright *Whirlwind*, it has a high speed of more than 200 mph.

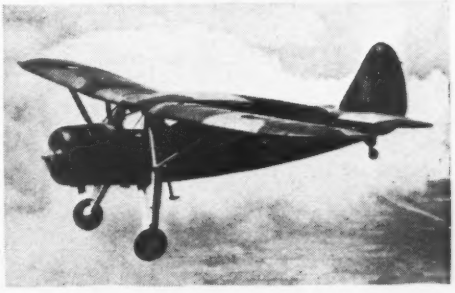


← **Fairchild PT-19A**

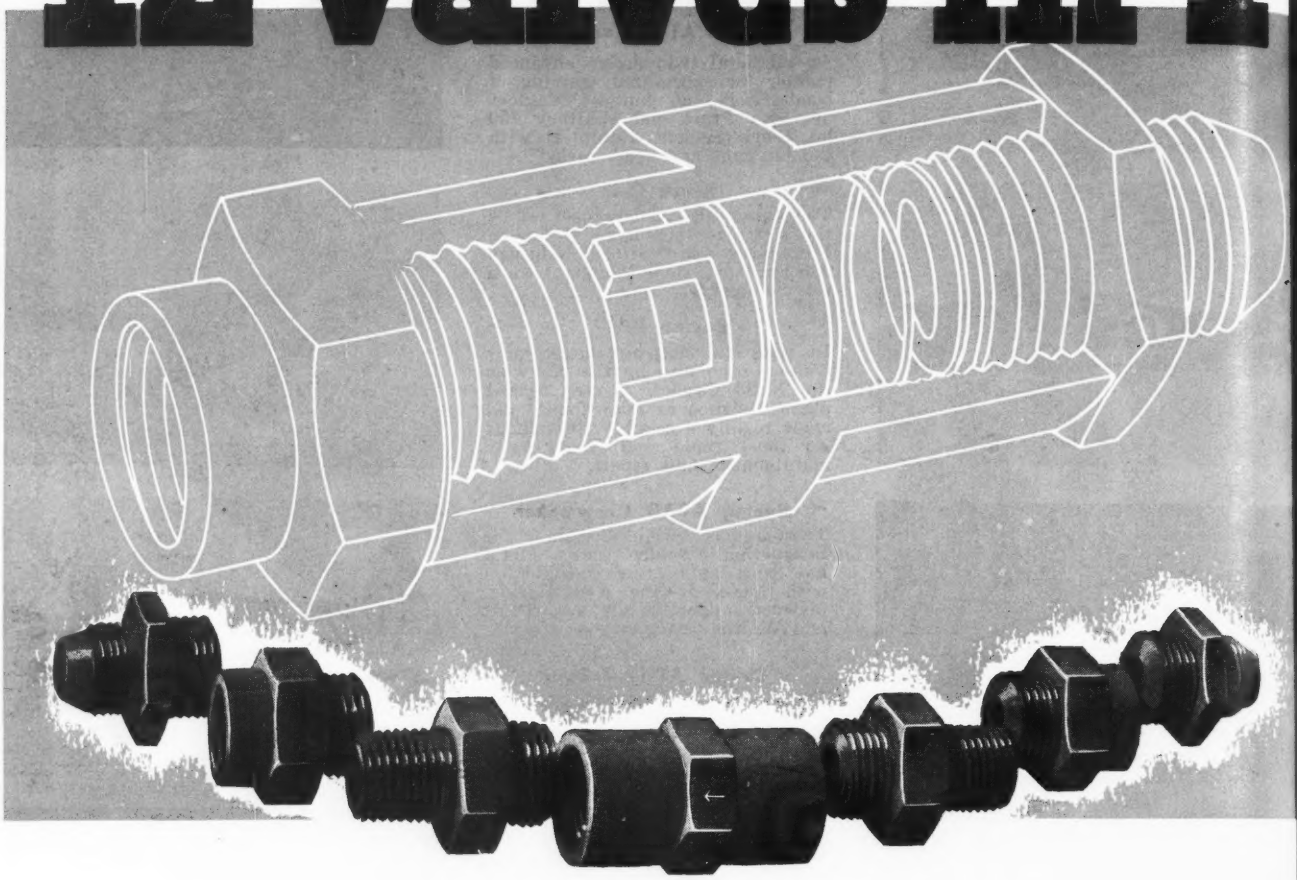
Used extensively by the AAF and Canada with the *Cornell* version, it was designed to facilitate transition to low-wing combat types. A 175 hp. Ranger engine gives it a top speed of 125 mph.

Fairchild C-61A *Forwarder* →

The war-service version of the famous F-24, familiar to many Civil Air Patrol activities, now in service as a personnel and light cargo plane.



12 valves in 1



New A S P Check Valves *for Hydraulic Lines are 16% Lighter*

Down comes weight. Up goes the number of connections possible with new A S P automatic Check Valves. Made of heat treated aluminum alloy, one standard body and two of three types of adapters provide twelve different combinations for connections with flared tubing or internal or external pipe threads.

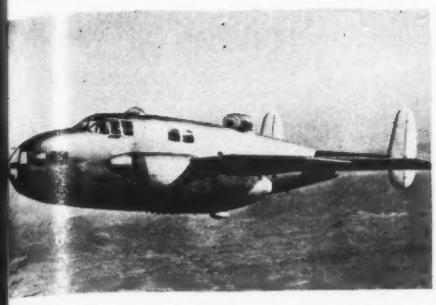
Each adapter has a seat for a light phenolic poppet which can be inserted at either end of the body. Large ports provide from two to four times greater fluid flow with minimum pressure drop. By using A S P adapters and reversing the poppets or the entire valve assembly, 100% selectivity in both flow direction and connections is obtained. Laboratory tests to 50,000 reciprocations and 275° F. developed no breakdown nor distortion.

A S P Check Valves are made in ⅜" and ½" sizes with either plastic poppets or single or double steel ball checks. They operate in any position, are unaffected by vibration, variable pressure or acceleration and give positive protection in critical lines. They cut inventory stock, costs, maintenance expense and provide all combinations.

Ask for new Bulletin

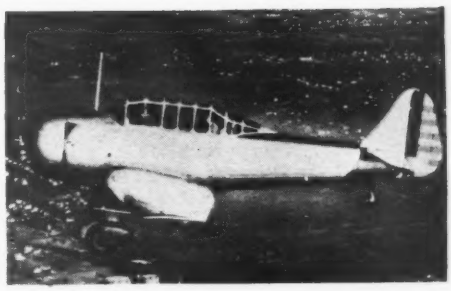
AMERICAN SCREW PRODUCTS

LOS ANGELES, CALIFORNIA



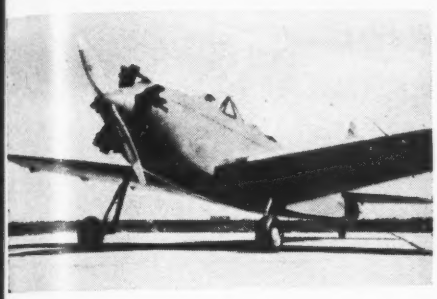
←Fairchild AT-14 *Yankee Doodle*

Duramold process-built crew trainer, accommodating two bombardiers, two pilots, navigator or radio operator, and gunner. Two 450 hp. Ranger engines give a top speed of 225 mph.



Fleetwings BT-12 →

The first military airplane built principally of stainless steel, being produced in quantity for the Army Air Forces with easy maintenance a prime design consideration.

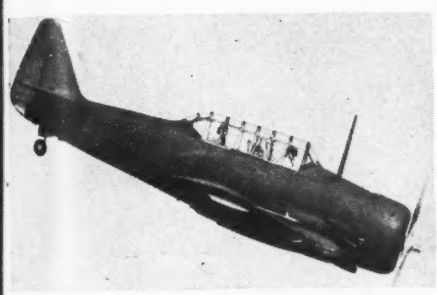


← Howard DGA

A two-place primary trainer with both fuselage and wings plywood covered. Fixed landing gear is of high strength to withstand rigorous training schedules. Engine, one 160 hp. Kinner.

Interstate L-6 →

Another of America's light planes which has gone into active service is the Interstate *Cadet*, now on duty as the L-6. Powered by a Franklin engine, its high speed is 114 mph.

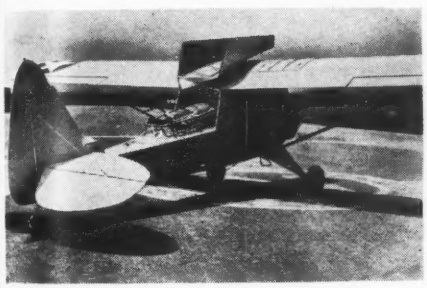


← North American AT-6

The famous *Harvard* combat trainer, of which more than 1,500 have been sent to train RCAF and RAF pilots. Used day and night at Kelly Field, Texas, to produce almost two thirds of the nation's finished pilots.

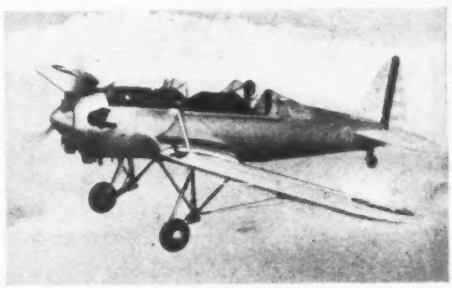
Piper L-4B →

Another popular civilian plane turned to liaison, reconnaissance, and observation for the Army. This plane has also produced thousands of fliers in the CPT.



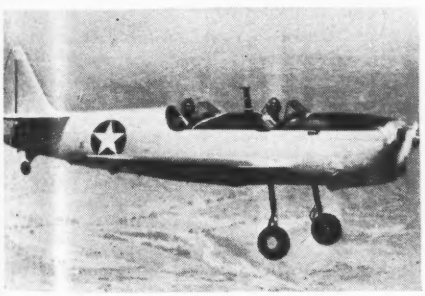
← Piper HE-1

This is a Navy ambulance conversion. Top rear of fuselage is hinged to open and admit a stretcher. Powered by a Lycoming 100 hp. engine, this plane can save much valuable time in rescue work.



Ryan PT-22 →

A standard primary trainer, widely used by Army and Navy, by the latter as the NR-1. Equipped with flaps and steerable tail wheel.

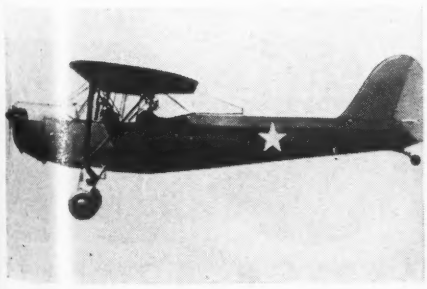


← Ryan PT-25

A plastic-bonded plywood trainer, with no strategic metals used except in the engine cowling. Powered by a Lycoming 185 hp. 6-cyl. horizontal opposed engine.

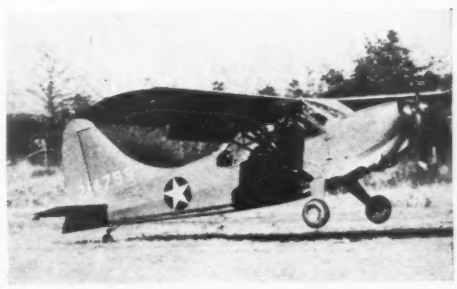
Spartan NP-1 →

A husky, two-place biplane trainer designed to train pilots for the naval air arm. It is powered by a Lycoming engine delivering 220 hp.



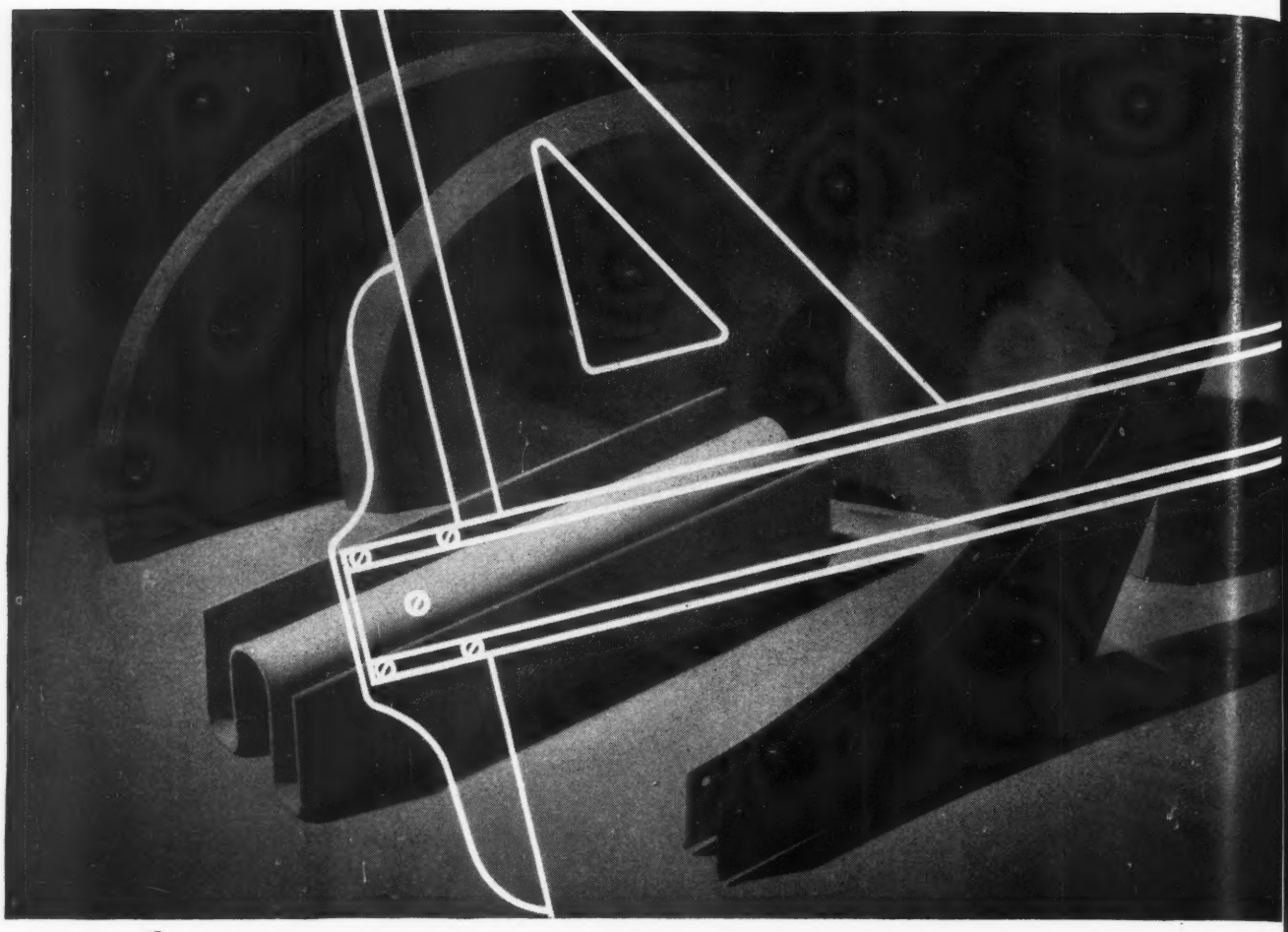
← Taylorcraft L-2B

One of America's best-known light planes now serving the Army. Modified slightly, it is designated the L-2B.



Vultee-Stinson L-5 *Sentinel*→

A two place liaison spotter for the Army. Powered by a Lycoming 190 hp. engine. Equipped with slots and flaps, it has a wide speed range, short take-off, low flying speed, high top speed.



Born on a Napkin at the "Greasy Spoon"!

DESIGNERS often get their inspirations at odd times and places. Many a tablecloth sketch has become a finished product faster because the "dreamers" were thinking in terms of Laminated INSUROK.

Because Laminated INSUROK is versatile and supplied in many grades, it gives designers greater latitude—permits them to solve problems created by lack of other critical materials—helps them meet the demands for faster production without requiring special equipment or causing unnecessary losses because of rejects.

Do you have a war-product, or post-war design problem which might be solved by the use of molded or laminated plastics? If so, write us; we'll be glad to furnish the details and characteristics of INSUROK Precision Plastics.

The Richardson Company, Melrose Park, Illinois; Lockland, Ohio; New Brunswick, New Jersey; Indianapolis, Indiana. Sales Offices: 75 West Street, New York City; G. M. Building, Detroit, Michigan.

INSUROK *and the experience of Richardson Plasticians are helping war products producers by:*

1. Increasing output per machine-hour.
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6. Doing things that "can't be done."
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INSUROK

MADE AND SOLD ONLY BY THE RICHARDSON COMPANY

Liaison-Trainers and Gliders

American

← Vultee AT-19 *Reliant*

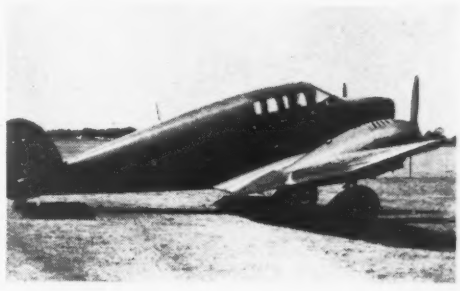
The peacetime Stinson *Reliant* is assigned to the British for navigation training of naval flyers. Powered by a Lycoming 285 hp. radial engine, this plane has a high speed of 155 mph.

Vultee BT-15 *Valiant* →

A two place basic trainer known as the *Valiant*, powered by a Wright 450 hp. radial engine. High speed is 166 mph, cruising, 140 mph. Wings are plywood, landing gear is fixed.

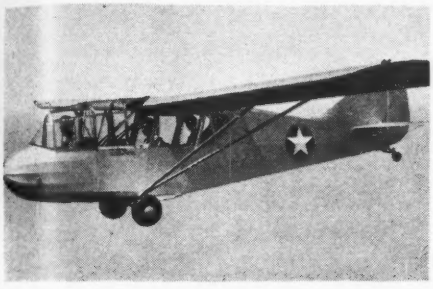
← Waco UPF-7

A "workhorse" of many CPT schools, this well known plane has been used extensively for giving embryo combat pilots their first acrobatic training.



Langley 2-4-90 →

Now the product of the Andover Kent Aviation Corp., this four-place cabin monoplane is of molded plastic-bonded plywood construction. High speed in 150 mph.

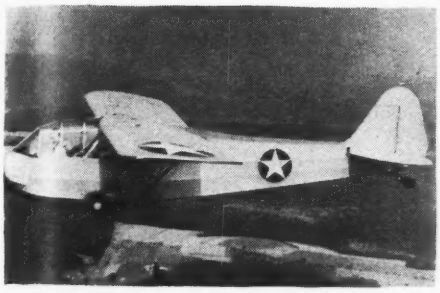


← Aeronca TG-5

One of America's best known light planes in another war role—the Aeronca trainer converted to the TG-5, a three-place training glider. This model has been widely used by the Army Air Forces.

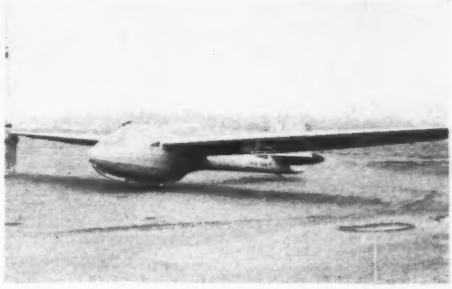
Funk Trainer →

Also in the list of American light planes joining the glider forces is this conversion of the Funk Model B75L two-place training plane. Performance data are restricted pending completion of flight tests.



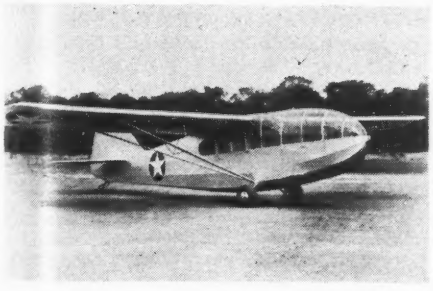
← Piper TG-8

The famous Piper *Cub* metamorphosed by speedily wrought design changes to become the TG-8, a three-place tandem glider used by the Army Air Forces in its swiftly-established program to train pilots for cargo-transport gliders.



LNE-1 →

A new glider built by Pratt, Read and Co., on which no information has been released. Built for the Navy, performance withheld.

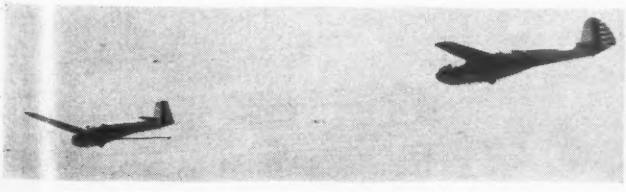


← Taylorcraft TG-6

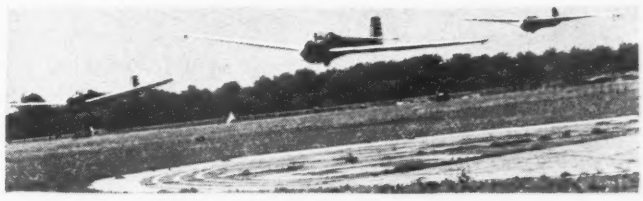
Quickly adapted from the famed Taylorcraft 65 hp. Tandem trainer is the TG-6, a three-place training glider being produced in quantity for the Army-CAA program.

CG-4 Troop Carrier →

Designed and first built by Waco, this standard troop-carrying glider is made almost entirely of non-strategic materials. Now in mass production.



Two different makes of gliders being towed aloft in training activities.



Practice in group take-off, preparing for possible troop-glider flying.

MAKING EACH HOUR A MORE *Productive* ONE····

Model "THTF-L-6" Center Control 6000 Pound Capacity Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms Standard Forks up to 36" long Telescopic Lift up to 119"

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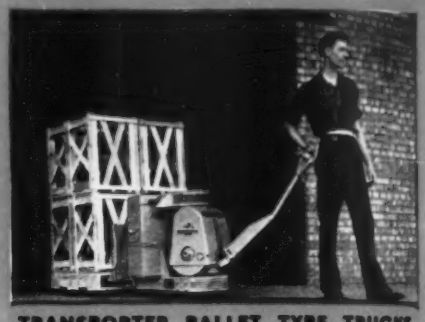


TRANSPORTER PALLET TYPE TRUCKS

Model "P-427" Pallet Type 4000 Pound Capacity "TRANSPORTER" Fork Type Lift Truck. Standard Established Fork Lengths Are Minimum 30" to 60" Maximum in 2" Steps. Standard Fork Height in Low Position is 3⅜". Lifting Height from Low to High Position is 3¼" (Get P-427 Bulletin for Full Details).

PLATFORM TYPES

Model "TN-4 and TW-4" 4000 Pound Capacity and Model "TN-6 and TW-6" 6000 Pound Capacity "TRANSPORTER" Platform Type Lift Trucks for Skid Platforms—Standard Platform Lengths 36" to 72" in 12" Steps. Widths 20" and 26½"; Heights in Low Position 6"; 7"; 9"; 11"; (For Full Details Get "TRANSPORTER" Platform Bulletin).

TRADE AUTOMATIC MARK *Standard* VICTORY MODELS

NOTE: Some "AUTOMATIC" approved models can be furnished with specifications meeting "Industrial Truck Association Spark-Enclosed Equipment" for operation in heavily laden dust or vapor atmosphere such as in arsenals, ammunition depots, and ordnance or chemical warfare plants. These are models "LN-2"; "TLN-2"; "THTF-L-4"; "THTF-L-6"; and "TRANSPORTER" platform and pallet type lift trucks.

Each "AUTOMATIC" Approved Standard VICTORY Model will have the same time-proven features, quality materials, precision workmanship, sturdy construction, and guarantee under which the entire line of "AUTOMATIC" has already won wide industrial acceptance for highly efficient and economical materials handling.

"AUTOMATIC" is ready to serve you now as always without obligation through nationwide Material Handling Representatives who are fully experienced in the application of "AUTOMATIC" equipment. These men are listed in the classified telephone directories in the principal cities and industrial areas under "Trucks, Industrial." In many instances proper planning and co-ordination now with standardized equipment for war production will serve you efficiently for post war activity.

All models are approved types to conserve vital materials and speed up war production materials handling

- Model "TLN-2" 4000 Pound Capacity High Lift Tiering Platform Truck for Skid Transportation and Stacking.
- Model "TLN-3" 4000 Pound Capacity High Lift Tiering Platform Truck for Skid Transportation and Stacking.
- Model "LN-2" 4000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation.
- Model "LO-5" 10,000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation.
- Model "LN-3" 6000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation.
- Model "THTF-M-10" Heavy Duty Center Control 10,000 Pound Capacity Telescopic and Non-Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms.
- Model "TETF-7" Rear Control 7000 Pound Capacity Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms.
- Model "TLO-5" 10,000 Pound Capacity High Lift Tiering Platform Truck for Skid Transportation and Stacking.
- Model "CHTF-2" Center Control-Light Duty 2000 Pound Capacity Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platform.

MANUFACTURERS FOR OVER 35 YEARS *Electric Propelled* INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION CO.

DIV. OF THE YALE & TOWNE MFG. CO.

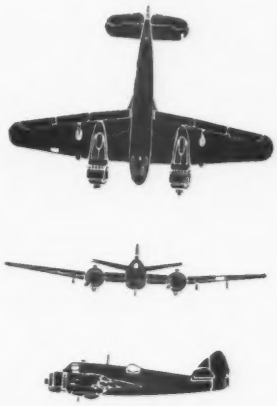
63 WEST 87th STREET CHICAGO, ILLINOIS

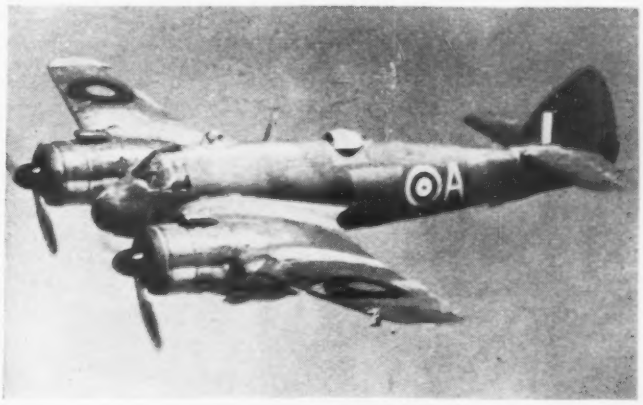
Blackburn *Skua*

A two-place dive-bomber for carrier use. Span, 46 ft. 2 in., length, 35 ft. 7 in. Engine, one Bristol *Perseus* 9 cyl. 905 hp. radial. Top speed 225 mph. at 6,500 ft., cruising speed, 144 mph. at 15,000 ft. Service ceiling, 20,200 ft. Gross weight, 8,228 lb. Armed with four .303-cal. machine guns in rear of cockpit. Bomb load, 600 lb. Not comparable with our own types. Britain has used several American carrier-based craft.

Bristol *Beaufighter II*

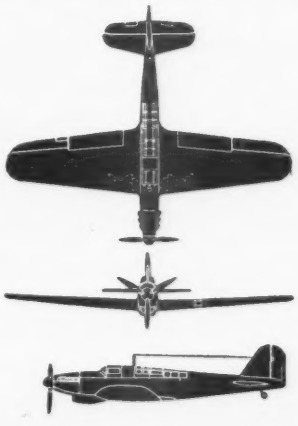
The *Beaufighter II* has replaced the radial engines of the first model with two Rolls-Royce *Merlin XX* engines, developing 1170 hp. at 21,000 ft. Its top speed is up to 352 mph. Range 1,330 mi. at cruising speed of about 295 mph. Service ceiling is 33,000 ft. It is somewhat lighter than the earlier model. Armament is still four 20-mm. cannon in the nose and six .303-cal. machine guns in the wings. General appearance is the same except for the engines and dihedral in the tailplane.





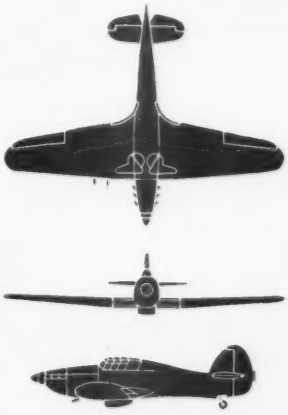
Fairey *Fulmar*

Another two-place carrier-based fighter-bomber, powered by a Rolls-Royce *Merlin X* of 1145 hp. at 5000 ft. This plane is rather large for the type, having a span of 47 ft. and a length of 40 ft. Top speed is about 300 mph. Armament consists of eight machine guns in the wings. No performance figures are issued on this plane, but its prototype cruised at 230 mph. at 15,000 ft., had a service ceiling of 29,000 ft. and a range of 1,000 mi. with improvements undoubtedly achieved in the later model.



Hawker *Hurricane II*

Single-place, medium altitude fighter. This later model has the Rolls-Royce *Merlin XX* 12 cyl. 1175 hp. engine. Top speed, 385 mph. at 15,000 ft. Cruising speed, 255 mph. Range, 500 mi. at 215 mph. Service ceiling, 36,000 ft. Span, 40 ft., length, 31 ft. 6 in. Weight, loaded, 7,547 lb. Armed with four 20-mm. Hispano cannon in wings, or twelve .303-cal. Browning machine guns in wings. Used as a low altitude plane, it may carry two 250-lb. bombs, or one 500-lb. bomb under the wings.



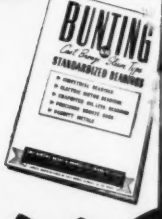
British Air Ministry

AMERICA IS BUILDING 'EM

"Bigger and More Deadly"

In the nightmares of the Nazis looms a huge winged thing, the very lines of which suggest its vast and lethal power. It is the super-bomber from America, described by military experts as "bigger and more deadly" than any ever before produced.

Bunting Bronze Bearings fly with many of the big bombers. In the powerful engines of these great destroyers, in the landing gear, tail gear, and at other important points are the Precision Bunting Bronze Bearings that are making history in bearing design and manufacture. The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

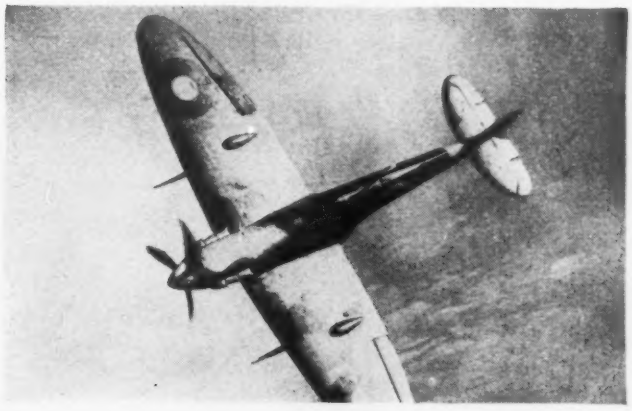


Bunting

BRONZE BUSHINGS ... ARINGS • PRECISION BRONZE BARS

Supermarine *Spitfire* V

One of the world's outstanding high altitude fighters it—with its medium altitude teammate the *Hurricane*—is credited with a major role in winning the Battle of Britain. Constantly increased power and refinements make the V one of the fastest single-seat fighters in operational service, for it has a top speed of over 400 mph. Armament consists of four 20-mm. cannon or two 20-mm. cannon and four 0.303 machine guns. Of all-metal construction except for fabric covered control surfaces, it has a span of 36 ft. 10 in., length of 29 ft. 11 in., and height of 11 ft. 5 in. Powered by Rolls Royce *Merlin* XLV.



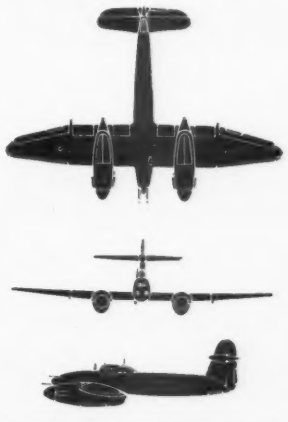
Supermarine *Spitfire* IX

This latest model of the *Spitfire* is slightly longer than the V to accommodate the Rolls-Royce *Merlin* 61 engine with its new two-stage supercharger with intercooler. This installation requires use of a four-blade, full feathering propeller. Principal difference in appearance is the head-on view of, in addition to the familiar engine radiator under the right wing, there is another under the left wing for the supercharger. Nothing has been released on performance other than that it is faster and has a higher ceiling than the V. Armament consists of two 20-mm. cannon and four .303 machine guns.

British Combine

Westland *Whirlwind*

This is Britain's first twin-engine, single-place fighter. The engines are Rolls-Royce *Peregrines* of 850 hp. each. Top speed may be about 400 mph., but little information has been released. Unusual features are the untapered, tubular fuselage, and the stabilizer and elevator placed high up on the fin. Ships now being used as a low-level bomber and Army cooperation plane.



Blackburn *Roc*

Basically the same design as the Skua, the *Roc* differs from its predecessor through addition of a four-gun power turret, slightly greater dihedral and 6 in. more wingspan. Obsolete by modern standards for carrier-borne dive bomber standards, it has been largely superseded by later types, some of them American. Powered by one Bristol *Perseus* nine cylinder radial engine delivering 905 hp., it has a top speed of approximately 225 mph. at 15,000 ft. Gross weight, including bomb load of about 600 lb. is a little over 8,000 lb. Service ceiling is listed as 20,000 ft. Span is 46 ft. 8 in., and length 35 ft. 7 in.

Boulton Paul *Defiant*

Though relegated to a secondary role by newer types of planes, the *Defiant* won its spurs in the Battle of Dunkirk. In the first appearance there, one squadron accounted for 37 German planes without a single casualty. Unusual use of retractable fairing around the four-gun power turret helps give the *Defiant* high performance for a craft of its size and weight. It is powered by a Rolls-Royce *Merlin III* of 1030 hp. at 3,000 rpm. at 16,500 ft. Span is 39 ft. 4 in., length is 35 ft. 4 in. and height 11 ft. 4 in. (Also see AVIATION, Sept. 1942, p. 201.)

Helen of Troy, *U.S.A.*

This was the truth the face that launched a thousand American ships? She was so beautiful, so serene . . . and so damned uncomfortable!

Not alone from the bustles and the corsets and the voluminous billows of tent cloth. Daily her life was besieged with the drudgery and the discomforts of the Gilded Age: The flat iron, the wood stove, the wash tub and the carpet beater, gaslight and the coal grate, horsecars and hansom cabs. But all these things have changed . . . miraculously and wonderfully changed.

And that's the theme of this story: *Change!*

For today the world is changing faster than ever before, and the first 5 years after this war will be equal to any 25 years of the past. Because this is true, we at Jones & Lamson have an important story to tell.

We were already 50 years old when Helen of Troy was a girl. We began with the birth of the Machine Age in America, and even in the very birthplace. Many of the precision machine tools designed and developed by Jones & Lamson engineers during more than a century of the company's history have literally made possible much of America's industrial change.

Because of this background and reputation, Jones & Lamson engineers have actually been called upon by manufacturers — from the largest to the smallest — many thousands of times for counsel, service, or precision machine tools during a single year of this war!

If your business is manufacturing with metal . . . if you have problems today . . . and if you are looking ahead to the swiftly changing markets, products and methods of manufacturing after the war . . . Jones & Lamson engineers and service men can help you. They are at your call!

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Die Heads

JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.

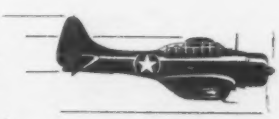
Profit-producing Machine Tools

PERFORMANCE CONTROLS THE AIR

Pesco Fuel Pump
Standard Equipment
on Many Planes

Partners in victory, pilot and plane scream earthward to silence hell's fury. A life and a conquest are entrusted to the performance of thousands of parts . . . parts that *must* be perfect. It's our duty here at home to see that every part *is* perfect.

In Aircraft Hydraulics, Fuel Pumps,
Air Pumps, Related Accessories . . .



PERFORMANCE POINTS TO Pesco FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO

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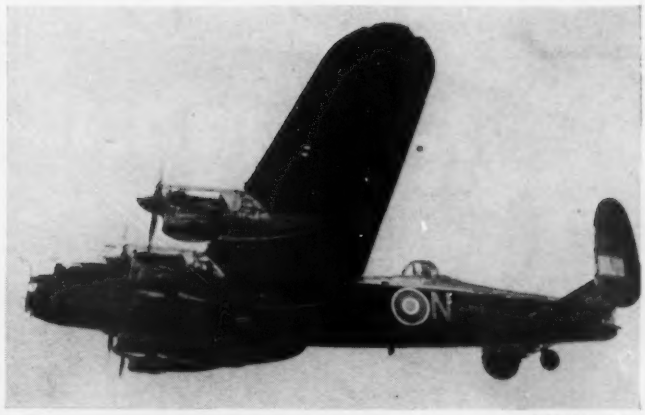
Avro *Lancaster*

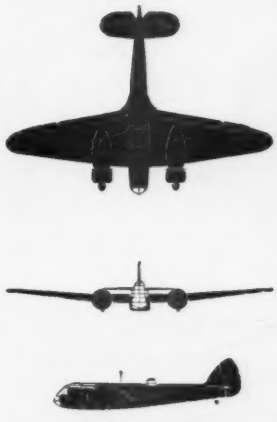
Britain's greatest bomber, a mid-wing monoplane with twin fins and rudders. Powered by four Rolls-Royce *Merlin XX* engines. A later model uses four Bristol *Hercules* 1600 radials. Top speed, 280 mph. empty. Range near 3,000 mi. with 15,800 lb. load. Weight loaded, 60,000 lb. Span, 102 ft., length, 69 ft. 2 in. Armed with four Nash and Thompson power turrets in nose, on top, underneath, in the tail. Unusually large bomb bay will hold a 4,000-lb. bomb, with 500-pounders, or six 2,000-lb. bombs, with others.



British Combine

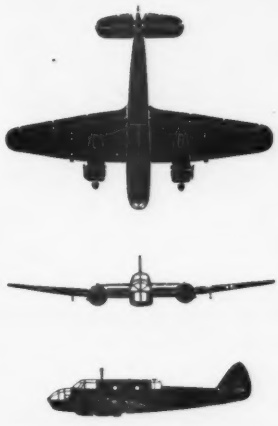
Bristol *Blenheim* IVF

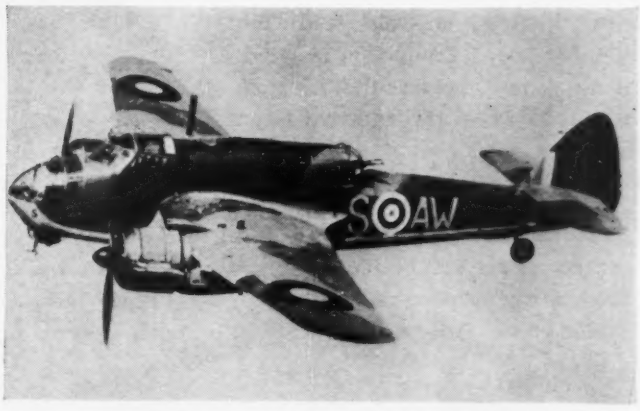
This three-place high speed long-range fighter-bomber has seen extensive service both in continental Europe and in the Mediterranean theatres. It has an official top speed of 295 mph. and a range of nearly 2,000 mi. Gross weight is 12,500 lb., weight empty, 8,100 lb. The bomber version is shown in the silhouette and the fighter version, with its four machine guns mounted in the blister under the fuselage, is shown in the photo. It is powered by two 840 hp. Bristol *Mercury VII* engines with three blade, controllable pitch D.H. propellers. Span is 56 ft. 4 in., length is 39 ft. 9 in., and height 9 ft. 10 in.



Bristol *Beaufort*

A four-place reconnaissance-bomber which has been used by the RAF Coastal Command as a torpedo plane, it also serves as a medium bomber, carrying a load of from 1,000 to 2,000 lb., depending on the mission. An unusual feature of its construction is the shallow fuselage aft of the dorsal power turret which is set just behind the trailing edge of the wing. It is armed with seven 0.303 machine guns covering the plane from above and below, in front and to the side. Powered by two 1145 hp. Bristol *Taurus* engines its top speed is 275 mph. Span, 58 ft., length 44 ft. 7 in.





De Havilland *Mosquito*

Britain's newest high-speed bomber, kept secret until after the raid on Oslo Gestapo headquarters. Largely plywood construction, with balsa wood employed. Span, 54 ft. 2 in., length, 40 ft. 9 in., height, 15 ft. 3 in. Engines, two Rolls-Royce *Merlin 21's*. Top speed is unrevealed, but is reported close to 400 mph. Armament may be four 20-mm. cannon and four 303-cal. machine guns. This plane is developed from the D.H. *Comet* which won the London to Melbourne race in the early thirties. Range may be close to 2,000 mi.

A minute wasted here, a second there . . . added up, the sum total of wasted hours might mean the difference between "enough, on time" and "too little, too late." Production is speeding ahead now, because the tiny time and material-wasters have been eliminated.

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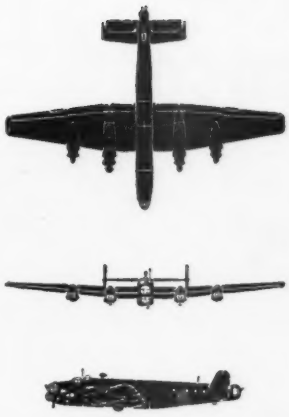
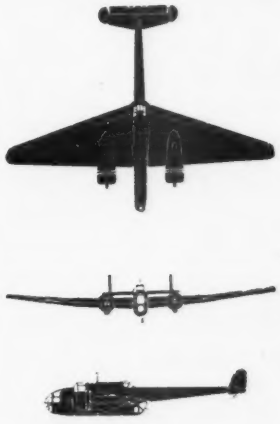
Handley Page *Halifax*

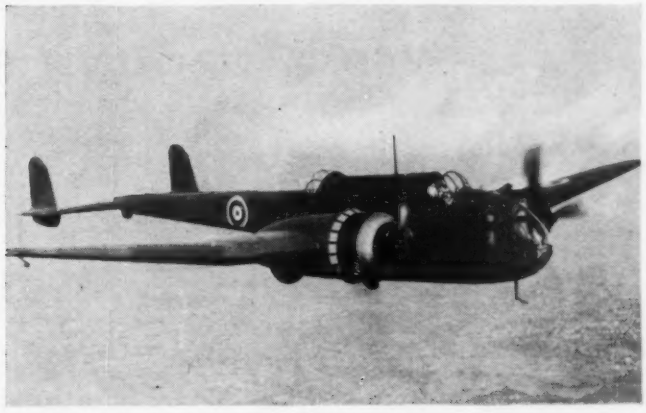
e of the first of the four-engine itish "heavies" to go into serv- , the "*Halibag*" has been used in ctically all of the large scale ids on Nazi war production nters. A prominent identifying ature is the "half-X" formed by leading edge of the twin fins. ur Rolls Royce *Merlin XX* en- es of 1260 hp. at 12,250 ft. give a top speed of 285 mph. Maxi- um bomb load is in excess of 00 lb., and range with that load said to be more than 1,500 mi. an is 98 ft. 10 in., length, 70 1 in., and height, 22 ft. It is med with nose, dorsal and tail rrets with a total of eight guns.



Handley Page *Hampden*

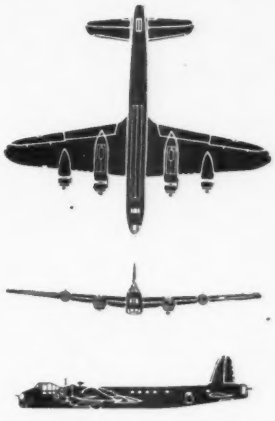
aging a come-back to active rvice as a mine layer, the *Hamp-* n had been largely superseded the later *Blenheims* and *Beau-* rts. Housing the entire crew d bomb load, a deep fuselage ck to the tailing edge of the ings accentuates its slenderness m there back to the twin fins d rudders. Dorsal and ventral n placements are installed just rward of the slender portion of e fuselage. The two 980 hp. ristol *Pegasus* engines give it a p speed of 265 mph. The *Hamp-* n has a wing span of 69 ft. 2 in., length of 53 ft. 7 in. and a ight of more than 15 ft.





Short *Stirling*

ong-range, heavy bomber, 7 to 10 lace. Engines, four Bristol *Hercu- s XI* 14 cyl. 1510 hp. Span, 99 t., length 87 ft. 3 in. Gross weight, 0,000 lb. Top speed, 280 mph. at 5,000 ft. Service ceiling 22,700 t. Range, 2400 mi. at cruising peed of 200 mph., with bomb load f 3,500 lb. Armament, two 303- al. machine guns each, in nose, orsal, side, and tail turrets. Maxi- um bomb load is 17,000 lb. With he *Lancaster* and *Halifax* it is ne of Britain's long-range, heavy oad carriers putting the German eople "in Coventry."



Short *Sunderland*

The hope of many a thirsty ship- wrecked crew, this long range flying boat has given valiant serv- ce in rescue and reconnaissance. Powered by four Bristol *Pegasus* 50 hp. radials, it has a top speed f 210 mph., cruising speed of 178 mph., a range of 2,000 mi. Span, 12 ft. 9 in., length, 85 ft. 4 in. Gross weight, 45,700 lb. Armed with gun turrets in nose, sides of op-rear, and tail. This ship pro- ects convoys and scouts for sub- marines over the whole European side of the Atlantic.

European

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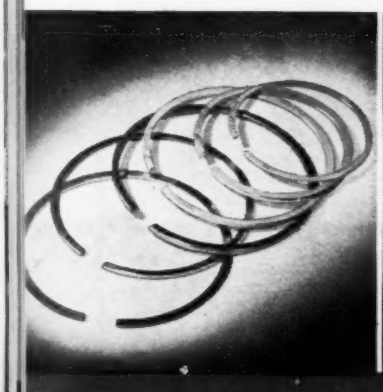
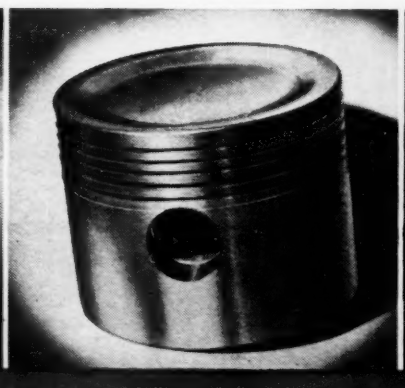
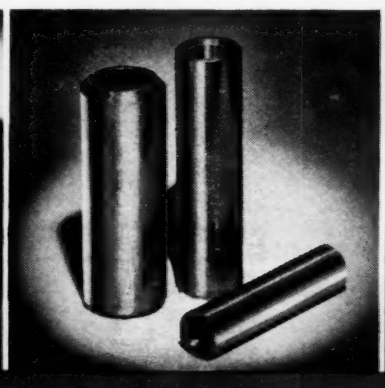
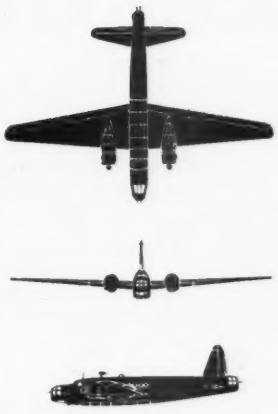




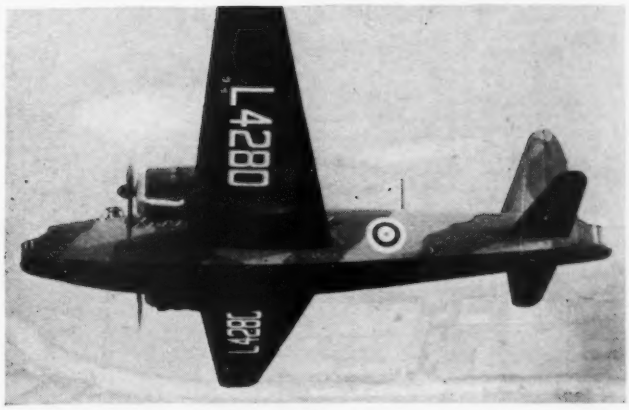
McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S.

CANADIAN PLANT, TORONTO, ONTARIO

Vickers Wellington III

ve-place long-range medium mber. This model has gone back radial engines, using two air- oled Bristol *Hercules XI* 1600 Span is 86 ft. 2 in., length, ft. 10 in., height, 17 ft. Gross ight, 32,000 lb. Bomb load, 4,500 Performance figures on the III ve not been released, but are doubtedly better than those of II, which has a top speed of 4 mph., service ceiling, 18,000 range, 1,580 mi. Armament of II was two 303-cal. machine ns each, in nose and tail turrets, d sides.

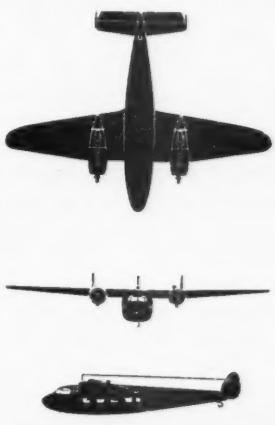




Cargo-Transport

De Havilland *Flamingo*

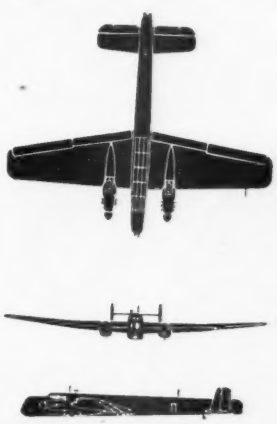
Twin-engine all-metal monoplane ransport used extensively for com- unication and transport. Powered two Bristol *Perseus XVI* 930 engines, with maximum speed 239 mph. at 6,500 ft., cruises 200 mph. at 10,000 ft. Service iling, 20,900 ft. Span, 70 ft., ngth, 50 ft. 7 in., height, 15 ft. in. Three-blade, full feathering opellers. Gross weight, 17,600 Carries a pay load of 3,200 Cruising range about 1,200 mi.

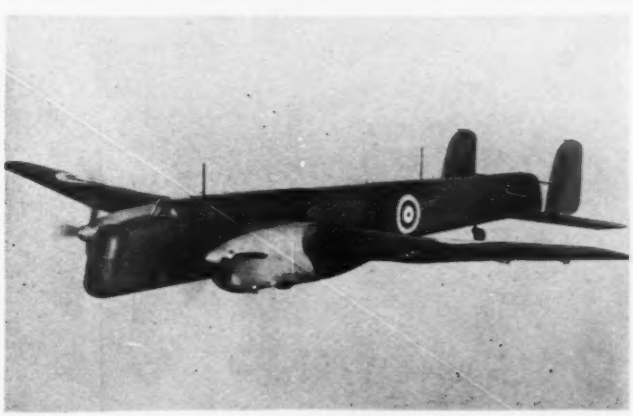


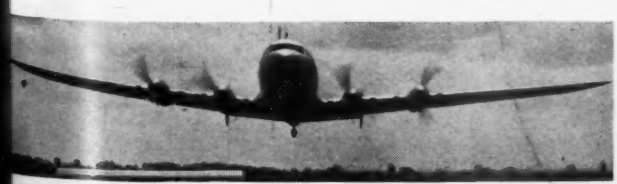
British Air Ministry

Armstrong *Whitley V* Transport

riginally one of the RAF's "work- orse" bombers in the early days the war, several of the *Whit- ys* have been converted for trans- ort work and now serve as cargo arriers for British Overseas Air- ays. Extra gas tanks are car- ed in the bomb bays, and addi- nal radio equipment has been stalled in the transport version. he only difference in appearance due to the removal of the nose nd tail turrets, these locations aving been faired over. Powered two Rolls-Royce *Merlin X* en- ines, it has a top speed of 240 ph. at 18,500 ft., and a service iling of 25,000. Span is 84 ft., ngth is 70 ft. 6 in. and height is 5 ft.







De Havilland 91 *Albatross*

The largest all-plywood plane in service with the British. A four-engine, low-wing, twin-tail transport. Powered by four Gypsy *Twelve* 525 hp. inverted V-type engines. Span, 105 ft., length, 71 ft. 6 in., height, 22 ft. 3 in. Gross weight 29,500 lb. Cruises at 210 mph. at 11,000 ft. Service ceiling, 17,900 ft. Fuselage is monocoque construction of cedar plywood with balsa wood between. This construction is said to be similar to that used in the new *Mosquito*. The low power engines offer a great contrast to our own high powered, load-carrying "prime movers".

Armstrong Whitworth *Ensign*

Four-engine commercial transport, high wing monoplane. Span, 123 ft., length, 114 ft. Gross weight, 52,500 lb. Engines, four Wright *Cyclone* 900 hp. radial. Top speed, 210 mph. at 6,700 ft. Cruising speed, 180 mph. at 5,000 ft. Ceiling, 24,000 ft. Initial rate of climb, 900 ft. per min. Provided with split wing flaps to lower landing speed. Propellers, D.H. three-blade constant speed. Conventional landing gear, backward retracting.

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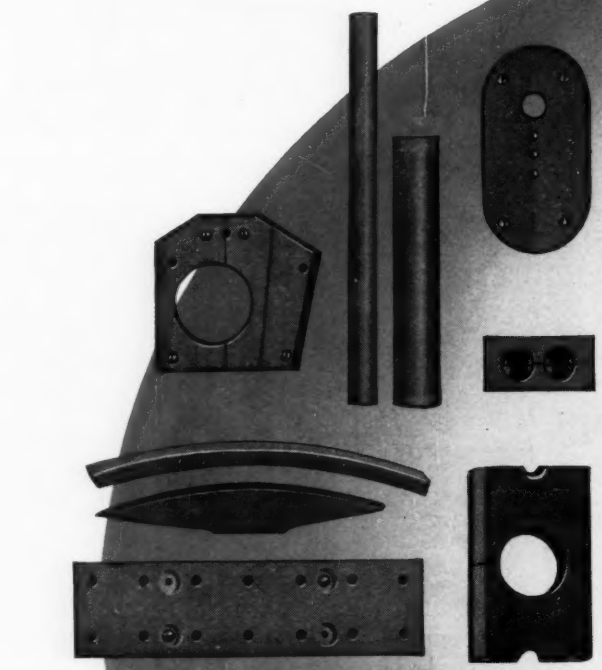

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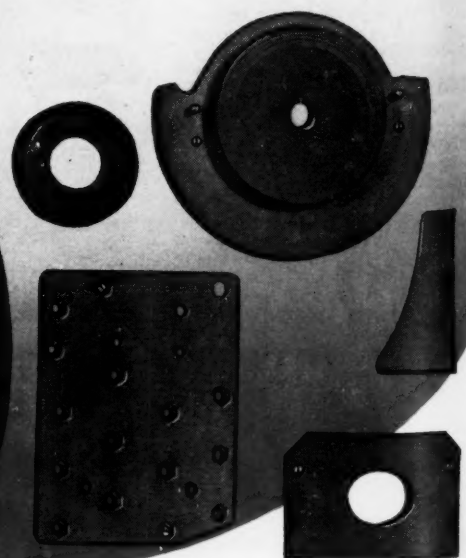


Westinghouse

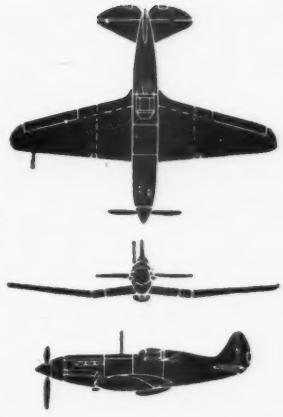
AIRCRAFT MICARTA

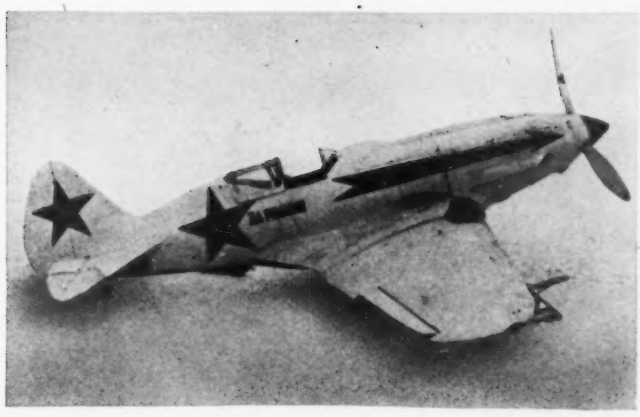
Fighters

Russian

I-18

Sometimes referred to as the MIG-3, this single seat fighter is one of Russia's newest combat craft to be put in service, and very little information on it has been released. It measures 37 ft, 6 in. in span, 81 ft. in length, and 10 ft. in height. Engine, one AM-35 V-type liquid-cooled 12 cyl. 1200 hp. Armament includes two 20-mm. wing cannon, two 30-cal. machine guns and two 50-cal. machine guns in cowl. The photograph at right shows the plane in winter paint, which will be changed to conventional camouflage with the advent of spring.

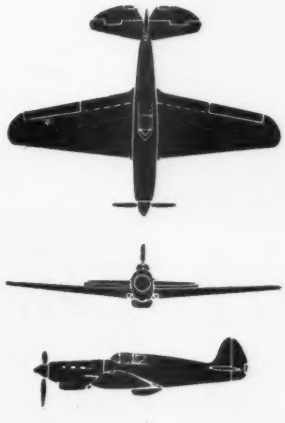


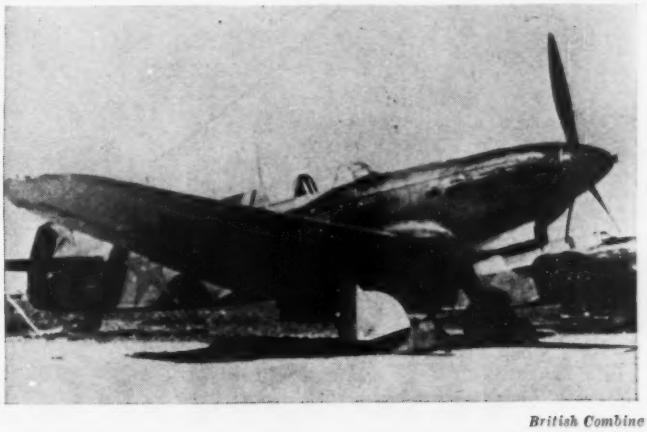


Sovfoto

Yak-1

Very little information has been made available on this thoroughly modern design single-seat fighter which has, on occasion, been referred to as the I-26. A very clean, full cantilever low wing mono, plane, it is powered by a Toupolev M-38, 1300 hp. engine, with a reported top speed of 400 mph. It is heavily armored, and is fitted with two 20-mm. wing cannon, four 55-cal. Maxim machine guns, position not stated. It is in the same size and weight class as the MIG-3, about the same length, and with a span of 40 ft.

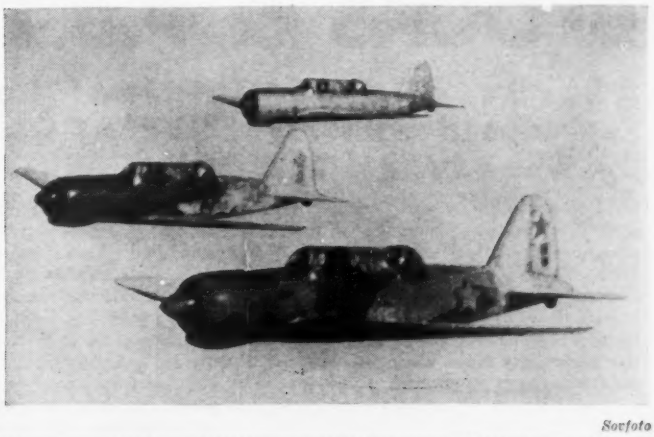




British Combine

SU-2

A two-place fighter-bomber which gives every outward appearance of having been developed from early model, American-built Brewster 8B2A *Bermudas*. It is, however, a completely independent design and according to reports from the Russian front, has proved to be a sound, dependable general purpose craft, capable of holding its own against the Luftwaffe. It is from the design board of famed Soviet designer Sergei Ilyushin. Armament details are not known but the plane is powered by a V-type 12 cylinder M-88 Hispano engine of 1100 hp.

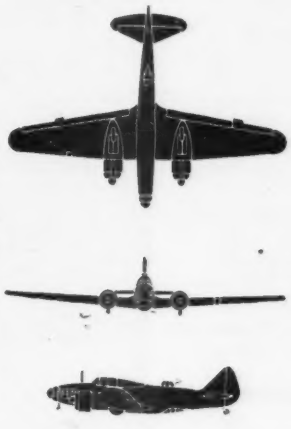


Sovfoto

Bombers

DB-3F

A medium bomber carrying crew of three or four. Designed by Ilyuchin, who has a long line of fine planes to his credit. Span, 81 ft. 2 in. No figures on length or weight are available. Powered by two M-88 Hispano-Suiza 12 cyl. 1100 hp. Top speed is reported in the neighborhood of 260 mph., and the range, about 600 mi. If these figures are accurate, it would not seem equal to our ships of the type. With a power turret showing in the rear, it is apparently heavily armed.



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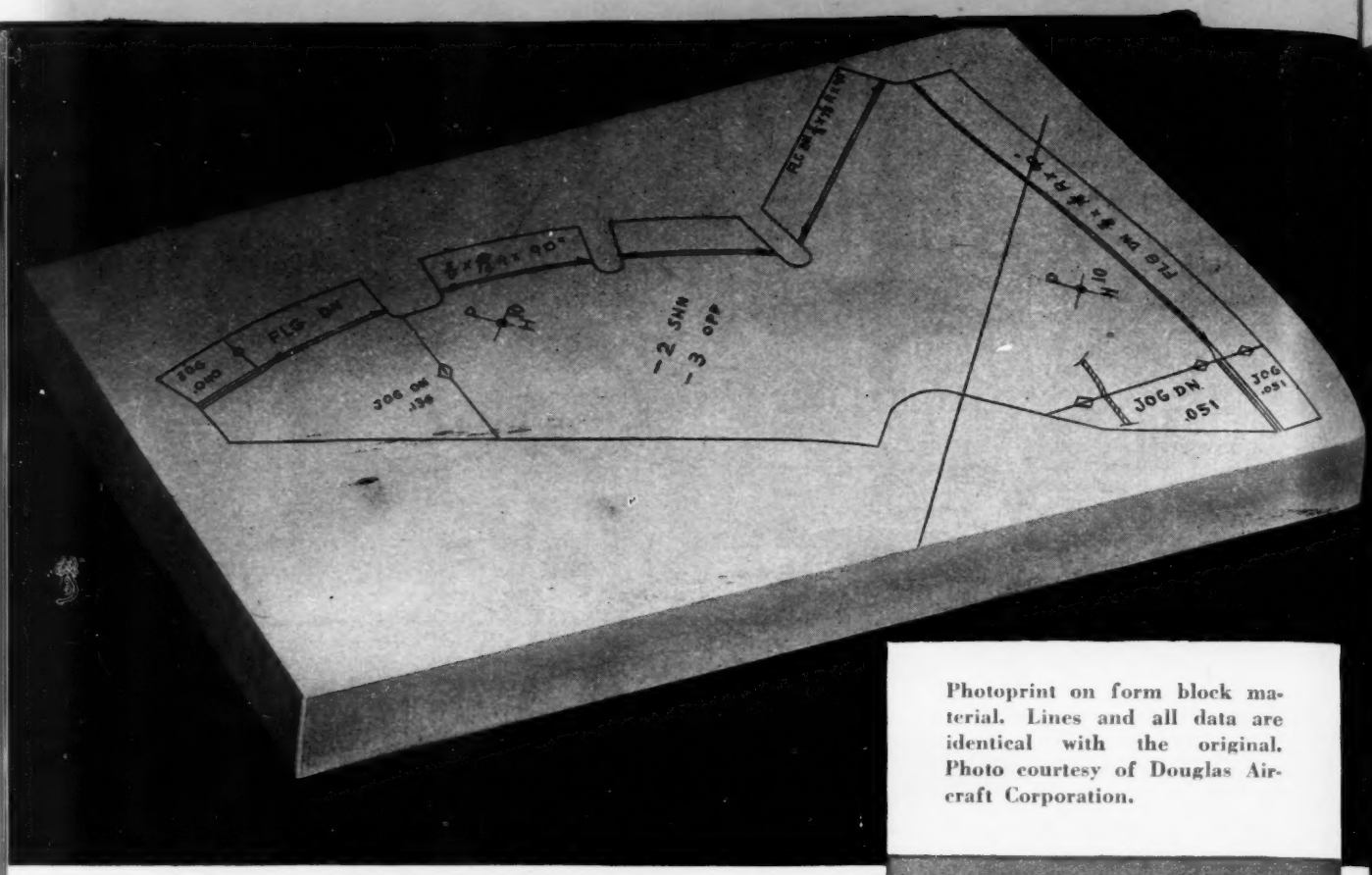

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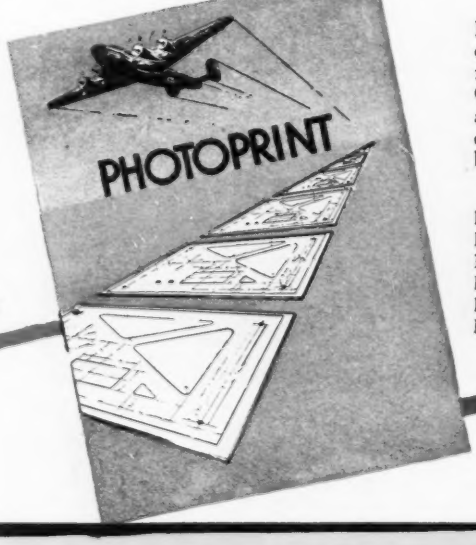

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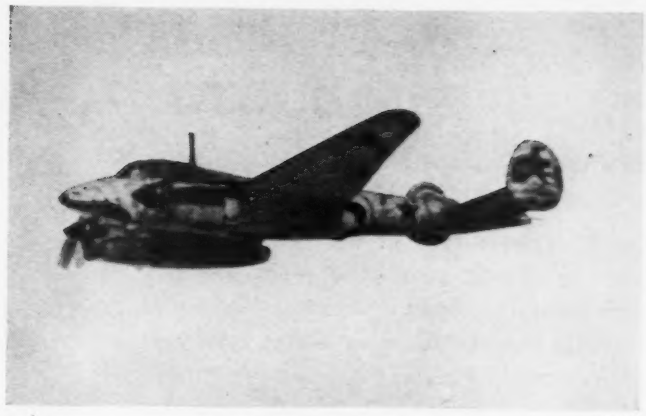
PE-2

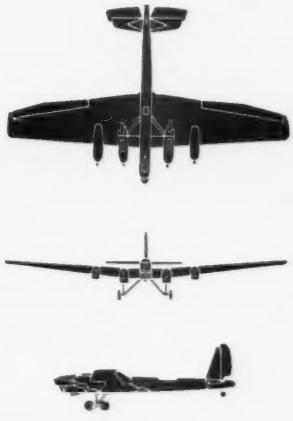
Also from design board of Ilyuchin is this three-place bomber which "doubles in brass" as a ground attack craft. As is the case with some of the German medium bombers, all crew members are placed ahead of the wing. The pilot and gunner are seated close together under the same canopy and the bombardier lies prone in a compartment in the lower part of the nose. Bomb load is reported to be between 1,500 and 2,000 lb. Two M-105 Hispano-Suiza 1300 hp. engines give a top speed of better than 300 mph. Span is approximately 56 ft., length about 40.



Sovfoto

TB-3

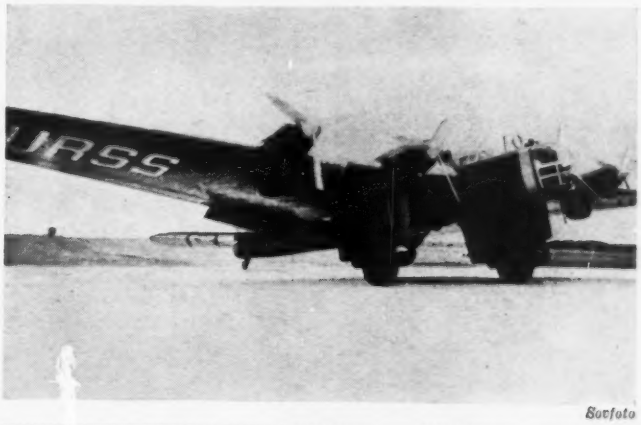
This is a four-engine bomber transport created by Toupolev; it is obviously an old design. Landing gear is fixed, with wheels paired in tandem. Engines are four M-34 Hispano-Suiza 830 hp. Top speed, about 130 mph., range, between 800 and 1,000 mi. Span is 138 ft., length 87 ft. Gross weight, 33,000 lb. Bomb load, 3,300 lb. Service ceiling, 16,400 ft. Ships like this, though old, have probably served their turn in Russia's battle of distances.



Sovfoto

TB-6B

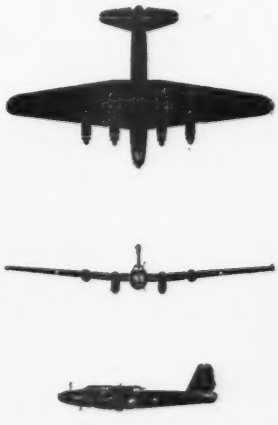
One of the most unusual features of this four-engine high altitude bomber designed by A. N. Toupolev, is the semi-retractable landing gear. The wheels retract a little more than half their diameter up into pants set beneath the inboard engines. Despite the drag resulting from these appendages, the craft has a top speed of approximately 230 mph. Four supercharged 1100 hp. Hispano-Suiza engines give the plane a better-than-26,000 ft. ceiling. Its range is in excess of 1,200 mi. Span appears to be better than 100 ft.

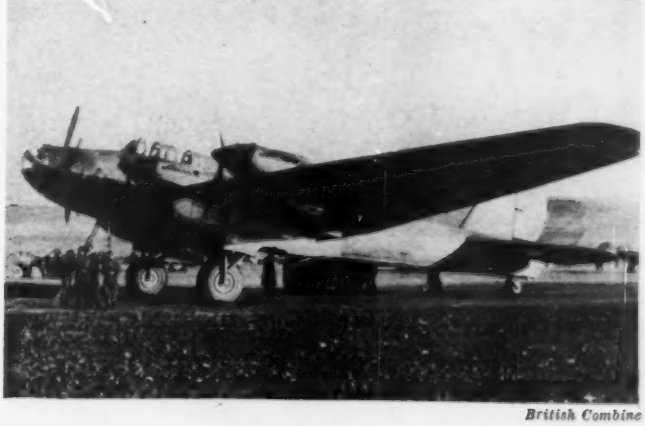


Sovfoto

TB-7

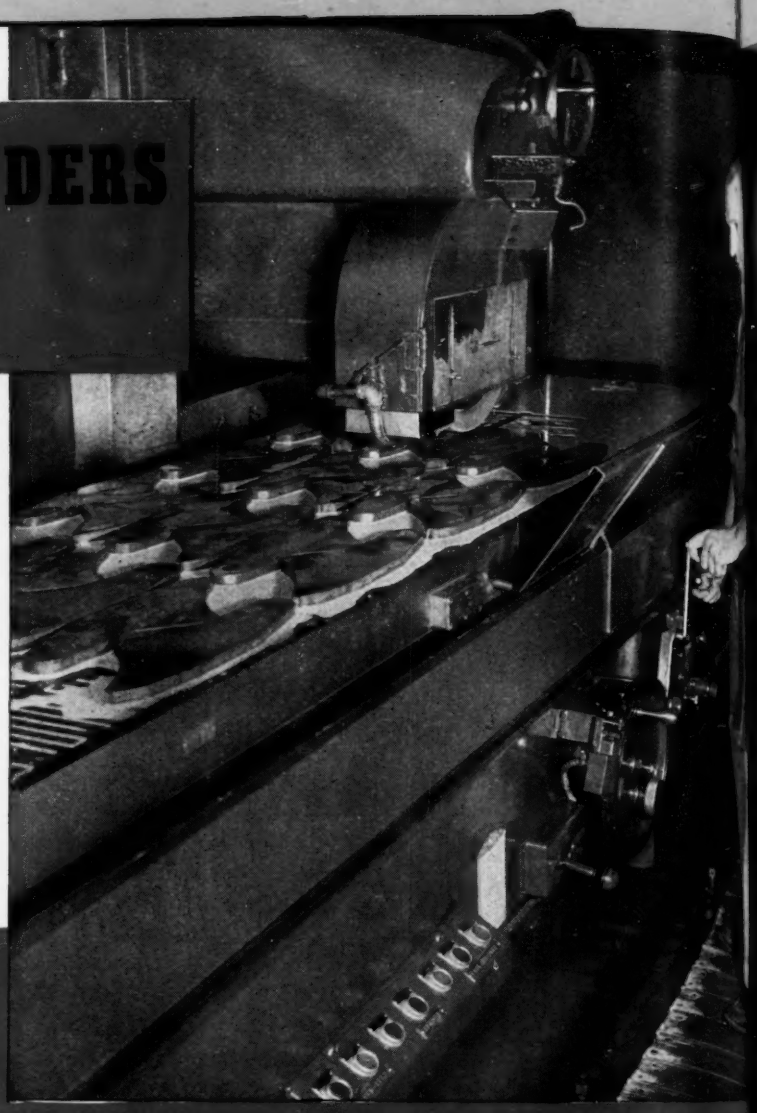
This is a midwing, singletail, metal monoplane of stressed skin construction which brought Soviet Foreign Commissar Molotov from Moscow via London to Washington. The engines are four 1300 hp. AM-38 12 cyl. liquid-cooled V-type. Top speed is 280 mph., service ceiling is 25,000 ft., and range is 2,500 mi. at cruising speed of 210 mph. Of interest are the central radiators, one for each pair of engines, and gun positions in the rear of both inboard engine nacelles. Other armament: multiple-gun turrets in the nose, one in top of fuselage, one in tail. Bomb load, 8,000 lb.





British Combine

THOMPSON GRINDERS
IN AIRCRAFT PRODUCTION



Terminal plates—one of the most important parts in aircraft construction—are precision ground on Thompson Grinders, as illustrated by these photographs from one of the plants of the Douglas Aircraft Co. (right) and Boeing Aircraft Co. (below). Both plants take full advantage of the convenient adjustments on Thompson machines to obtain speed and absolute accuracy. Numerous other aircraft parts are similarly ground on Thompson machines in these and other aircraft plants. Bulletins list all features—write for your copy.

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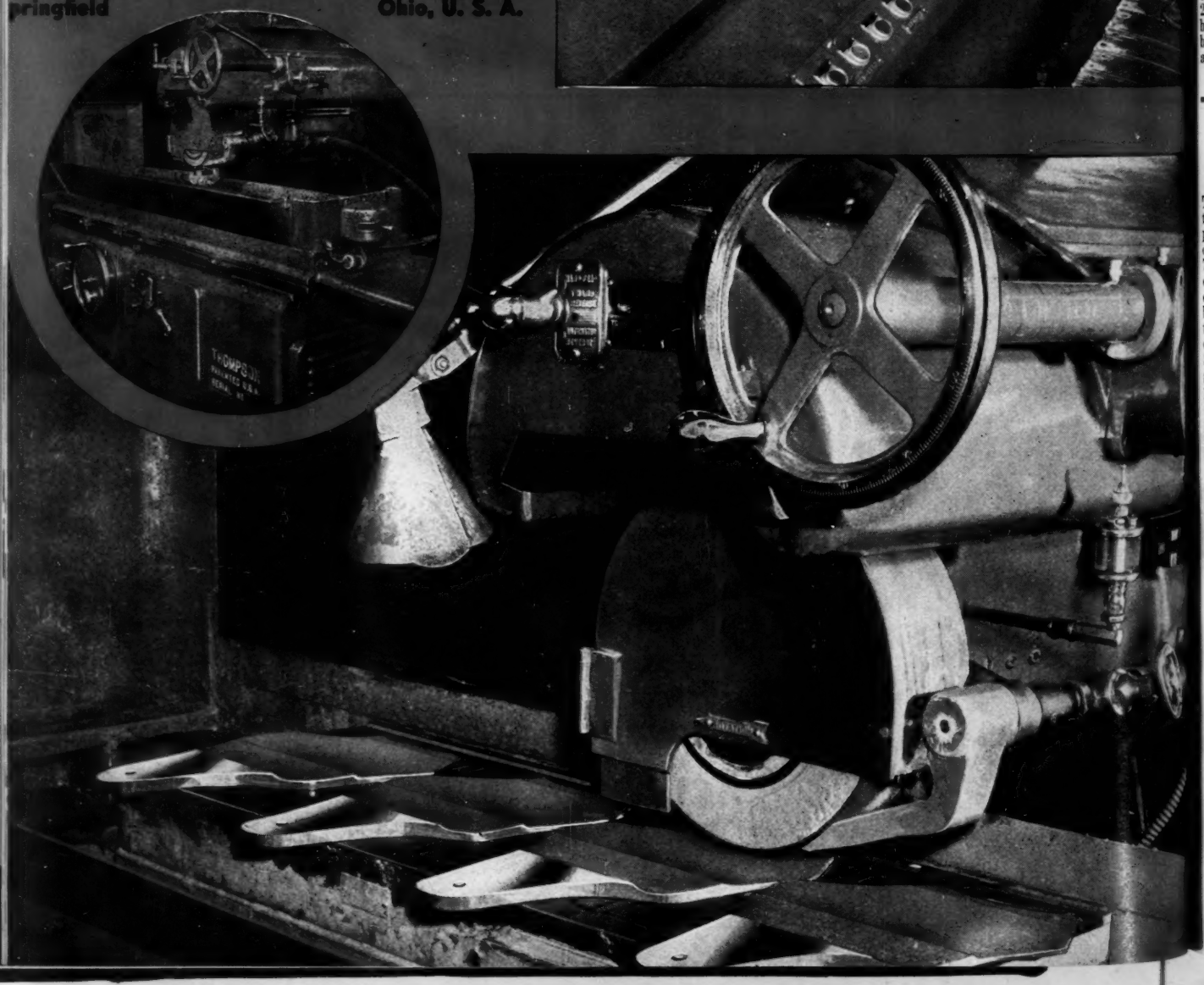
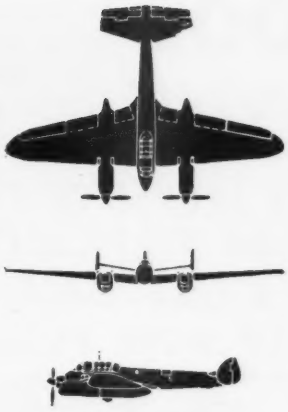


YAK-4

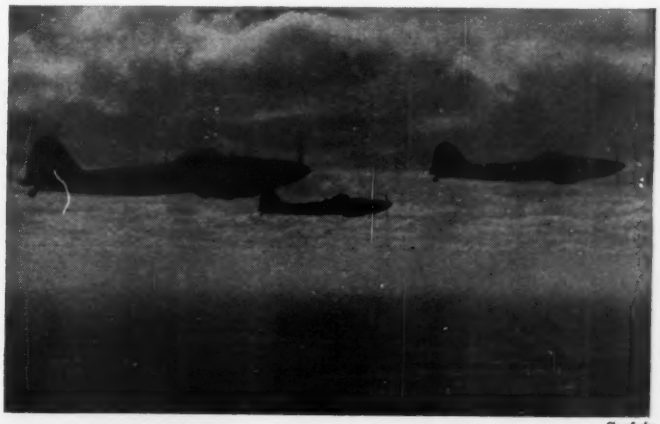
A twin-engine, two-place reconnaissance bomber, with alternate designation of BB-22, of Ilyuchin design. Two M-105 Hispano-Suiza 1150 hp. liquid-cooled engines give a top speed of 315 mph. Construction is of metal and plywood. Wings are provided with leading and trailing edge dive brakes. Further information has been withheld. It is similar in design to the PE-2, and both these planes are said to be based on the French *Potez* 63. Judging from others of the type, this new design is probably heavily armed.



Sovfoto

IL-2 *Stormovik*

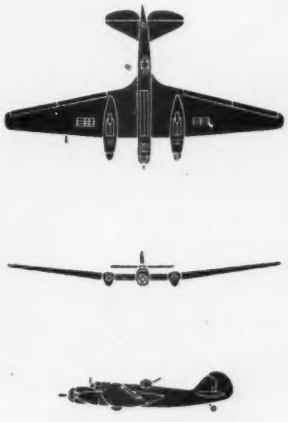
Perhaps the most famous of the Ilyuchin-designed planes is the *Stormovik* fighter and dive bomber which the Russians have used on a large scale as an army cooperation craft, dive bombing and strafing German mechanized troops. Armed with two 32-mm. cannon, four 50-cal. machine guns in wings. A Toupolev M-85, 1300 hp. engine gives a top speed better than 335 mph. fully loaded. Four 250-lb. rocket bombs, ten 100-lb. bombs, or one 1000-lb. bomb, can be carried for dive-bombing. Span, about 40 ft., length, about 34 ft.



Sovfoto

SB-RK

This is a dive-bomber version of the Toupolev-designed SB-3 three-place medium bomber. Dimensions of the SB-RK are the same—span, 70 ft. 6 in., length, 40 ft.—and outward appearance is the same except for the addition of venetian blind type dive brakes, similar to those found on the German JU-88 dive-bombers. High speed of the SB-RK is probably somewhat greater than the SB-3, since it is powered with two M-105 Hispano Suiza engines of 1100 hp. each, compared with the M-103's of 950 hp. each which power the level bomber version.



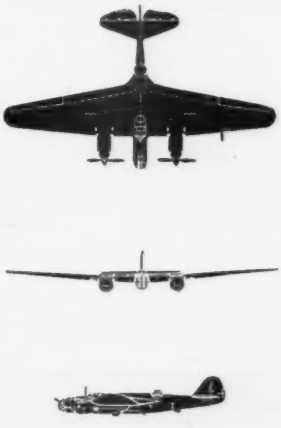
Sovfoto

AR-2

This is a new, two-place, light bomber development of the IL-2 *Stormovik*. The latter has a 1300 hp. Hispano-Suiza engine, and this has probably been improved upon in the AR-2. Armament is undoubtedly much heavier, as a nose cannon is clearly visible projecting through the propeller hub. The four machine guns of the *Stormovik* are probably retained, with the addition of a load of demolition bombs.

SB-3

Another of the Red Air Force workhorses by the prolific designer Toupolev, the SB-3 is a direct descendant of the SB-2, which was service tested in the Spanish Civil War and later in the drive against Finland. Dimensions are the same —span 70 ft. 6 in., length 40 ft.— but total horsepower has been increased from 1600 to 1900, giving it a top speed of about 280 mph. Versatility has been increased by addition, on many of the ships, of dive brakes similar to the type installed in the Nazi-built Junkers Ju 88's.



GST

The Consolidated PBY *Catalina* flying boat in Russian service. Some of the PBY-1's were exported, and others built under license. Powered by two Pratt and Whitney *Twin Wasp* 1200 hp. engines. Span, 104 ft., length, 65 ft. 1 in. Weight, loaded, 27,080 lb. Top speed, 190 mph. Range, 4,000 mi. Retractable wing-tip floats. These ships were built at Taganrog, on the Sea of Azov, long held by the Germans.

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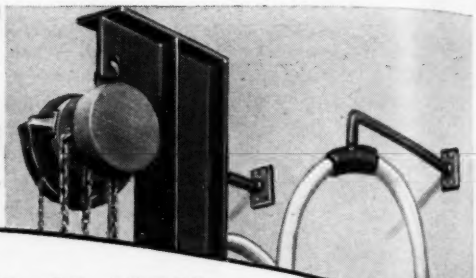

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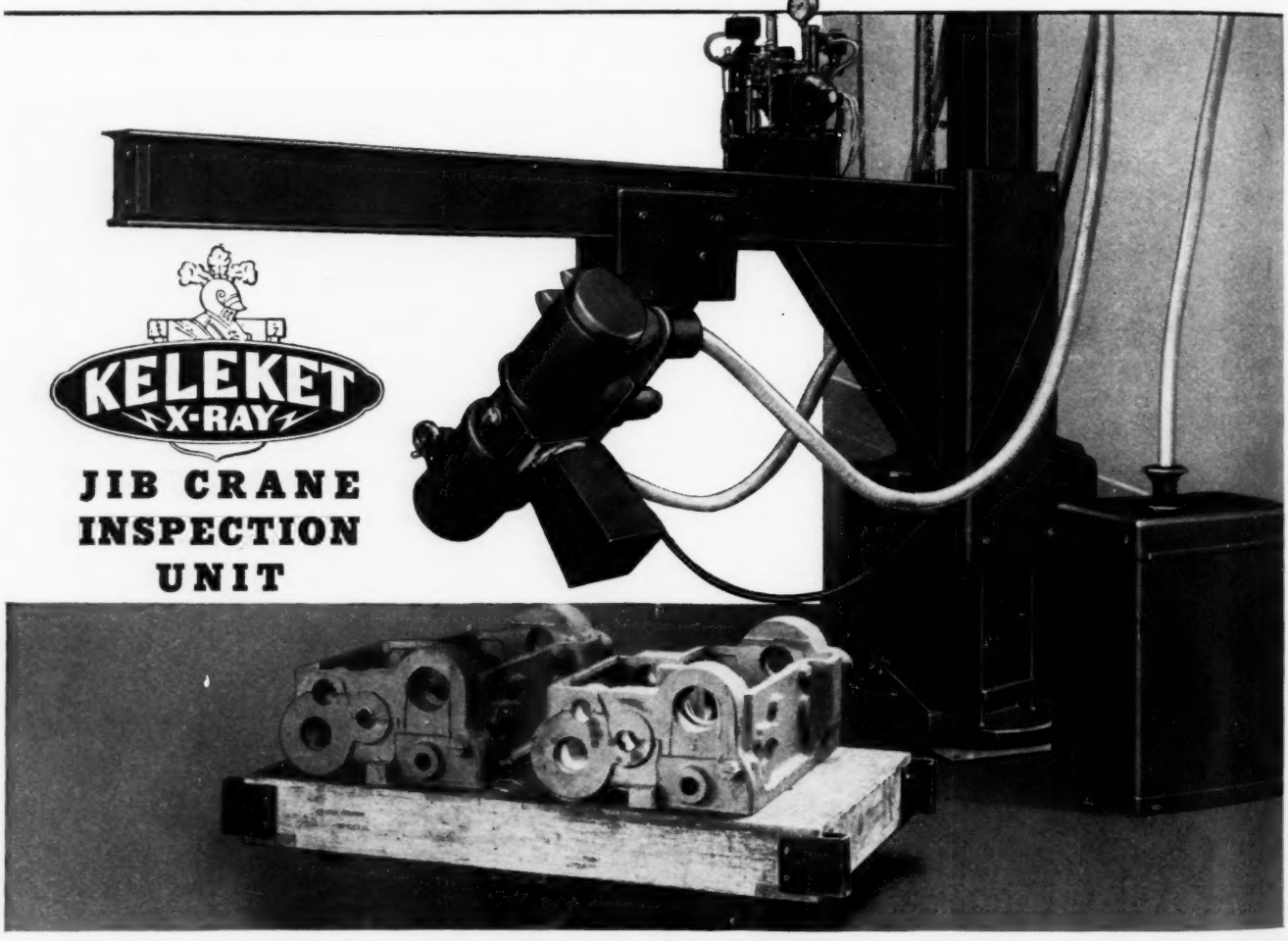

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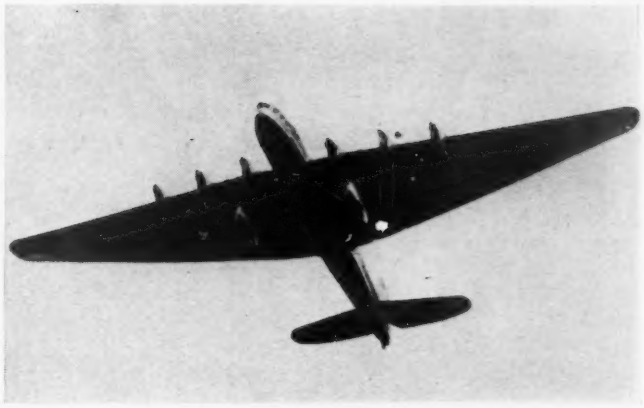
Russian

Cargo-Transport

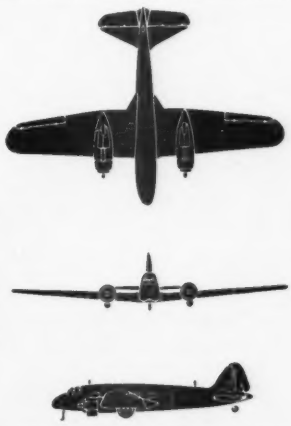
L-760

With a span of 210 ft.—just 2 ft. less than the Douglas B-19—this Toupolev-designed craft is one of the largest bomber transports in the world. Originally built as a commercial transport, it had accommodations for 64 passengers and a crew of eight. As a bomber it carries a crew of ten. The landing gear is non-retractable, the wheels being enclosed in spats about 15 ft. in height. Its success as a bomber undoubtedly depends on complete air superiority, for its six 1100 hp. Hispano Suizas give it a top speed of but 185 mph.



PS-35

An all metal transport, twin-engine, which appears to have been developed from Douglas types. Dimensions: span, 68 ft. 2 in., length, 49 ft. 2 in. Gross weight, 14,564 lb. powered by two Gnome-Rhone M-85 engines. Top speed, 248 mph., other performance figures not stated. It has been in civil air service in Russia since 1936, and is now used for military transport.



PS-84

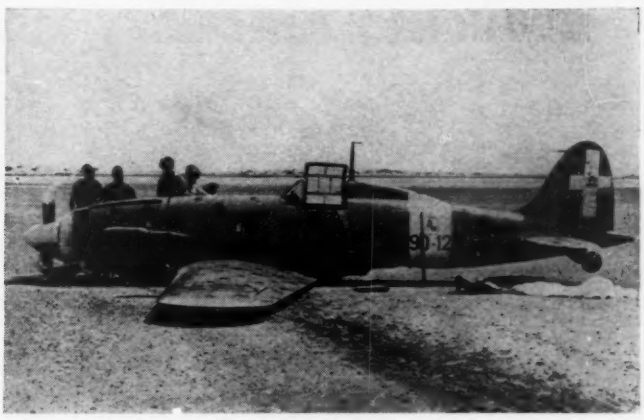
In this case, as in many others, the Red Air Force took into service the most readily available foreign types. Here is the ubiquitous DC-3. Span 95 ft., length, 64 ft., 5 in. Gross weight, 25,200 lb. Top speed, 219 mph. Range, 1,620 mi. Powered by two Wright *Cyclone* 1100 hp. engines. General description is already familiar, and can be found elsewhere.

Italian

Fighters

Macchi 202

This fighter is basically the same design as the 200, the most important change being adoption of the Mercedes-Benz DB-601 inline, liquid-cooled engine of 1150 hp.—furnished by the Nazis in an effort to bolster the Italian air force fighting power—instead of a radial aircooled power-plant. With a well streamlined form, performance is boosted to 335 mph., at 22,000 ft. Other changes in appearance are a long pointed nose, and a radiator, visible just below the pilot. Further data are not available.

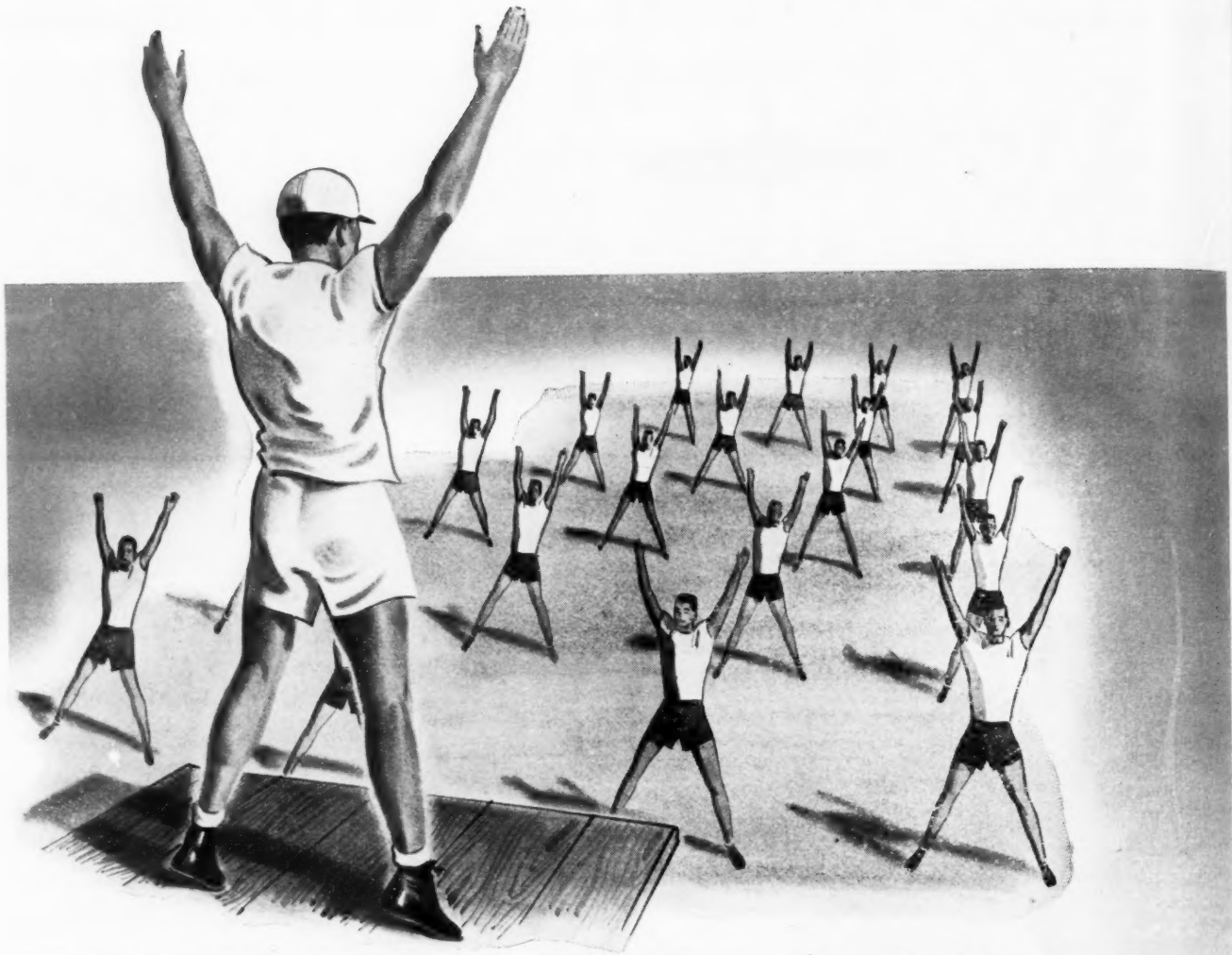


Reggiane RE-2000

Single-place fighter, very similar to the American-built P-43. Dimensions: Span, 36 ft., length, 25 ft. 9 in., height, 7 ft. 5 in. Gross weight, 5,610 lb. Powered by one Piaggio C-40 1000 hp. radial engine. Top speed, 330 at 13,000 ft. Service ceiling, 35,000 ft. Max-range, 810 mi. at 267 mph. Armed with two machine guns in wings. Landing gear retracts rearwards. A steerable tail wheel also retracts. Piaggio D'Ascanio three blade constant speed propeller. This plane was developed from a now obsolete American type.

Reggiane RE-2001

Single-place fighter, of the same basic design as the RE-2000. Slightly larger, the span is 36 ft. 9 in. length, 29 ft. 3 in. The radial engine of the earlier model is replaced with a Mercedes-Benz DB-601N 1150 hp. inverted V. Top speed is raised to 360 mph. at 22,000 ft. This installation makes a much more streamlined airplane, better able to cope with present war altitudes. The Macchi 202 made a similar improvement. Like the latest *Hurricane*, the RE-2001 has racks to carry small bombs.



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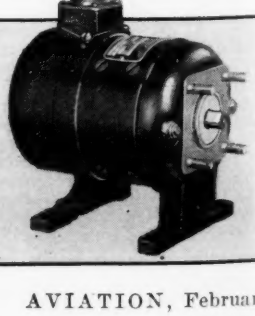
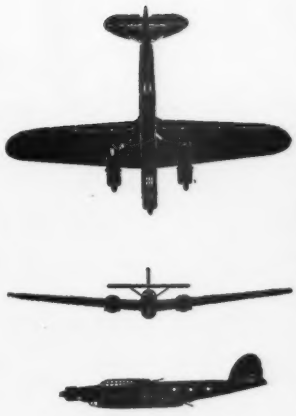


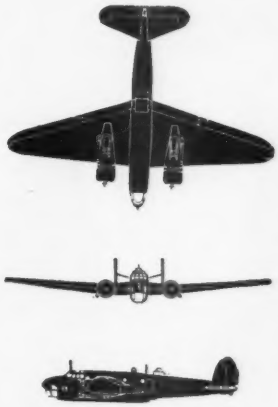
Cant. Z-1007bis

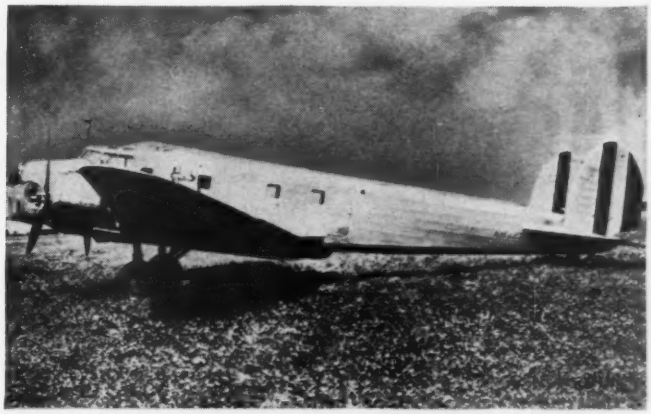
A typical Italian three engine heavy bomber, known in Italy as the *Alcione*, or *Kingfisher*. Span 81 ft. 4 in., length, 60 ft. 4 in., height, 17 ft. Powered by three Piaggio P.C-40 1000 hp. radials. Top speed, 280 mph. at 15,000 ft. Cruising speed, 235 mph. at 15,000 ft. Service ceiling, 26,500 ft. Cruising range, 800 mi. Gross weight is 38,360 lb. Bomb load, 2,600 lb. Armed with one 12.7-mm. machine gun in dorsal turret, one 12.7-mm. machine gun under fuselage, and two 7.7-mm. machine guns firing laterally.



Fiat BR-20M

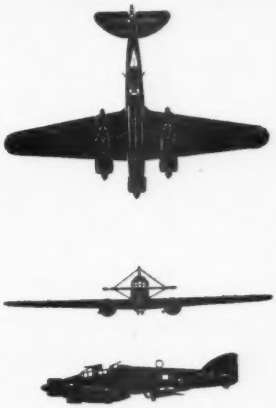
Twin-engine medium bomber, the *Cicogna*, or *Stork*. Span, 70 ft. 3 in., length, 52 ft. 10 in., height, 14 ft. 1 in. Gross weight, 22,220 lb. Engines, two Fiat A-80 18 cyl. 1000 hp. radials. Top speed, 268 mph. at 16,400 ft. Cruising speed, 220 mph. at 13,450 ft. Service ceiling, 25,000 ft. Range, nearly 1000 mi. Armament, one 12.7-mm. machine gun in retractable turret top rear. One 7.7-mm. machine gun bottom rear, one 7.7-mm. machine gun in nose. Bombardier sits forward below gunner. Fiat-Hamilton propellers.

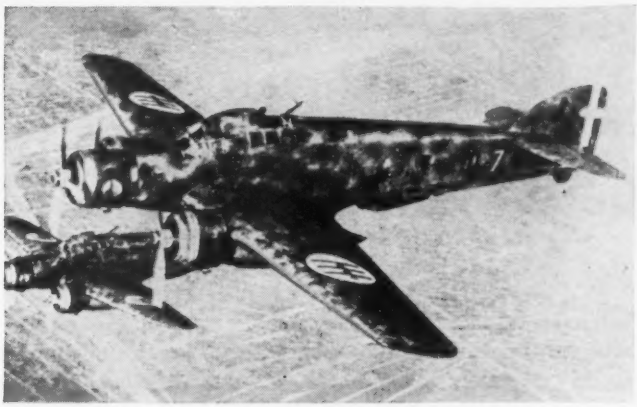




Savoia-Marchetti SM-79

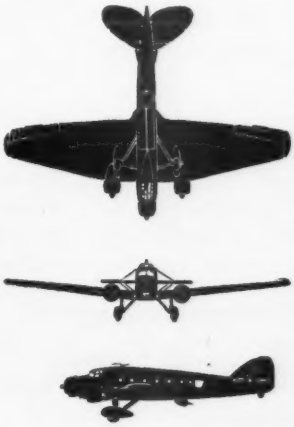
Another three engine medium bomber, the *Sparviero*, or *Hawk*. Span, 66 ft. 3 in., length, 53 ft. 7 in., height, 13 ft. 6 in. Gross weight, 23,100 lb. Powered by three Alfa-Romeo 9 cyl. 750 hp. radials. Top speed, 260 mph. at 13,500 ft. Cruising speed, 225 mph. at 16,400 ft. Range, 1,000 mi. Armament, one fixed machine gun forward, one flexible machine gun top rear of green house, one bottom rear, one on a laterally sliding mount covering both sides. Bomb load, 2,200 lb.





Savoia-Marchetti SM-81

Three-engine medium bomber, military conversion of the SM-73. Span, 73 ft. 8 in., length, 60 ft. 7 in. Gross weight, 20,500 lb. Engines, three Piaggio 700 hp. radials. Top speed, 211 mph. at 13,940 ft. Service ceiling, 22,960 ft. Range, 930 mi. Armament, two hydraulic turrets, with two 7.7-mm. machine guns each, one gun rear of greenhouse, one bottom rear. A fifth machine gun on a sliding mount covers both sides. The bombardier lies prone under center engine. Used in Ethiopia, now as a night bomber.



Bombs for Breakfast

As the man says: whatever goes up must come down. In the case of bombs, the all-important question is *where.*

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The other is *quantity*: the rate at which these bombers are built under the concentrated short-flow multiple-line production system which results in maximum output per man, machine and unit of plant space. Score one for Boeing production men.

There'll come a V-day when Boeing engineering and "productioneering" will turn from paths of war to paths of peace . . . from making the world unsafe for tyranny to making the new, free world a better, brighter one in which to live.

For in designing and building Flying Fortresses, Stratoliners, globe-girdling Clippers and other airplanes, Boeing continually acquires new "know-how" in many fields of engineering: electrical, structural, soundproofing, heating, radio, etc. It's the kind of "know-how" that helps to win wars, and will some day help to make peacetime products better and cheaper.*

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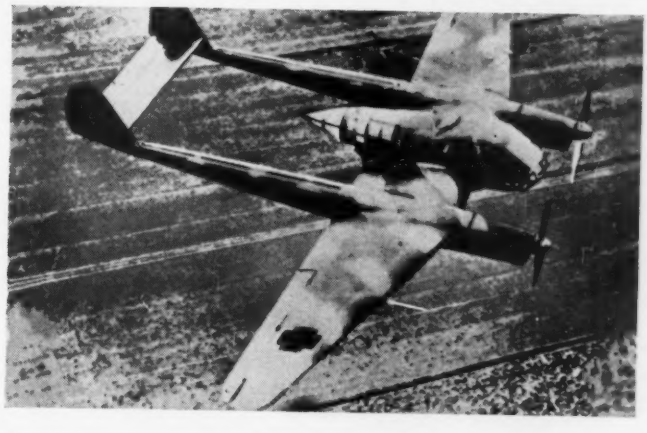
*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS

Focke-Wulf FW-187

An all-metal, twin-engine, single-tail, single-place fighter. Construction is monocoque, of four oval sections joined. Powered by two Mercedes-Benz DB-106 in-line 1050 hp. engines. Top speed, 360 mph. Absolute ceiling, 38,200 ft. Rate of climb, 1,130 ft. per min. Armed with two 20-mm. cannon and four machine guns in nose. Later models have 1325 hp. engines, and the speed of these is in excess of 400 mph. It is designed as a long-range fighter escort, and probably has a range of about 1,500 mi.

Focke-Wulf FW 189

A twin-boom, twin-engine reconnaissance fighter used extensively on the Russian front, the FW 189 is also occasionally used as an ambulance craft, having accommodations for two stretchers. Its normal crew numbers three. It is powered by two 8-cylinder Argus 410 inverted V-type aircooled engines developing but 450 hp. each, giving the plane a top speed of only 222 mph. at 8,500 ft. and a service ceiling of 27,500 ft. Armament consists of two fixed 7.9-mm. machine guns firing forward, one dorsal flexible and one fixed 7.9 in the tail.

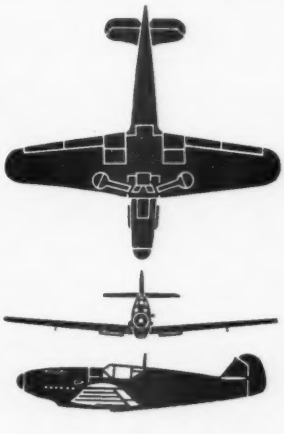


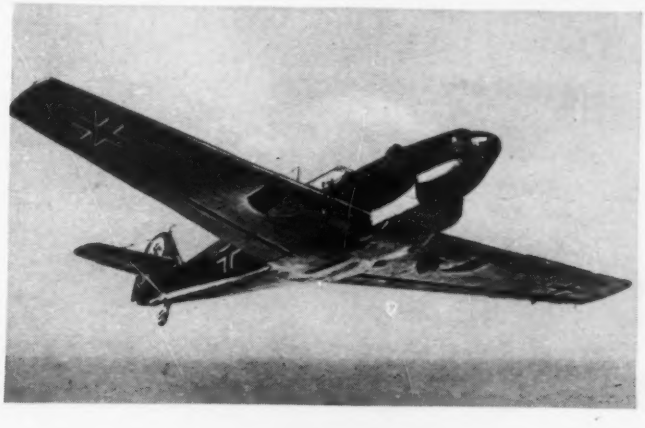
Focke-Wulf FW-190

First German single-place fighter to use the BMW 801, 1600 hp. 14 cyl. two-row radial engine. Top speed, 375 mph. at 18,000 ft. Range, 525 mi. at cruising speed of 275 mph. Initial climbing speed, 3,000 ft. per min. Service ceiling, 37,000 ft. Span, 34 ft. 5 in., length, 29 ft. 5 in. Weight, loaded, 8,380 lb. Armament, two 20-mm. Oerlikon cannon outboard in wings, two synchronized 20-mm. Mauser cannon in wing roots and two 7.9-mm. machine guns in cowling, synchronized. Duration of full firepower, 7½ seconds.

Messerschmitt ME-109F

This standard high altitude fighter is the outgrowth of models first put into full production in 1937. Without basic design changes, power has been upped from 650 to 1150 in the F. The G, with heavier armor and firepower, is said to have a 1600 hp. engine. Speed has been increased about 100 mph. to 365 or better in the F. Its supercharged Daimler-Benz engine gives it a service ceiling of 39,000 ft. Armament consists of one 23-mm. cannon firing through the propeller hub and two 7.9 machine guns. Span 33 ft., length, 29 ft. 8 in.





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Long before the day when he took the controls of this huge skyliner, the Clipper Pilot served an apprenticeship exacting in the extreme—an apprenticeship of countless hours aloft, under every conceivable condition, flying mostly "on instruments."

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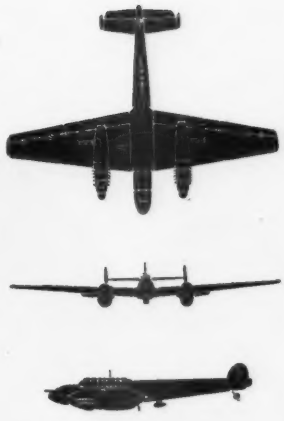
Messerschmitt ME-110

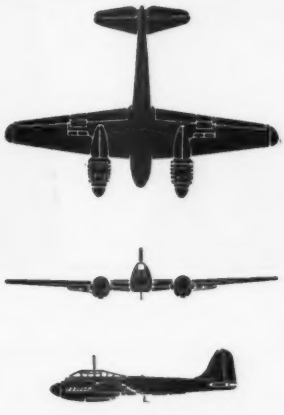
This standby of the German fighter force is a twin-engine, twin-tail low- wing monoplane, two- or three-place. Engines, two Mercedes-Benz DB 601 1150 hp. liquid-cooled. Span, 53 ft. 4 in., length, 40 ft. 8 in. Weight loaded, 15,200 lb. Top speed, 350 mph. at 20,000 ft. Service ceiling 35,000 ft. Range without extra tanks, 680 mi. Armed by two 20-mm. cannon and four 7.9-mm. machine guns in nose, one or two 7.9-mm. machine guns firing to rear. An external bomb load of 4,800 lb. can be carried on racks for short range missions and at medium altitudes.



British Combine

Messerschmitt Me-210

This model is a twin-engine, two-place, long-range fighter bomber, developed from the Me-110, but with longer range and larger bomb capacity. It is powered by two Mercedes-Benz 1450 hp. engines, with a top speed of 385 mph. at 18,500 ft. The span is 53 ft. 6 in., length, 36 ft. 4 in. The nose is shorter and more curved than the Me-110, and in a side view is obscured by long engine nacelles. Wings and tail planes are rounded, and the latter are not visible from head on. The armament consists of two cannon and four machine guns in the nose.



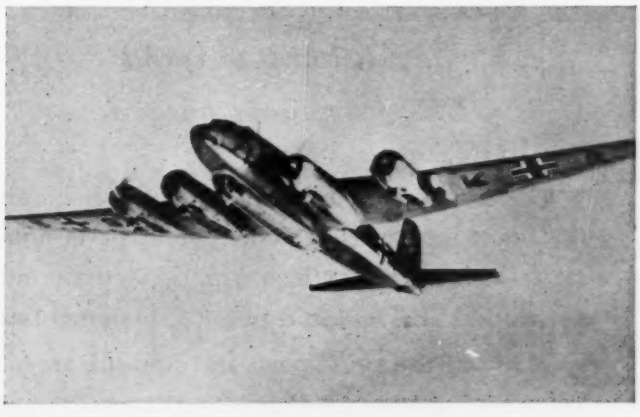
Heinkel He-113

Though it is a little-publicized craft, the He-113 is the fastest Nazi fighter. It is not, however, as effective at high altitudes as the Messerschmitt Me-109. Originally a "pilot killer" because of its high landing speed, it has been redesigned with wider tread inward retracting landing gear and has proved a thoroughly capable combat plane. A 1300 hp. engine gives it a top speed of over 380 mph. Span is 30 ft. 10 in., length is 26 ft. 11 in., and height is 8 ft. 2 in. It is powered by a Daimler-Benz DB-603 inverted V-type engine developing 1300 hp.

Bombers

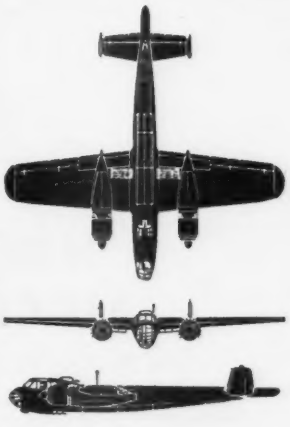
Focke-Wulf FW-200K *Kurier*

The military conversion of the FW-200 *Condor* transport, low-wing monoplane. Reported to be powered by four BMW 801, 1600 hp. two-row radials. Top speed, 279 mph. at 18,000 ft. Range from 2,500 to 3,000 mi. according to load. Service ceiling, 23,850 ft. Weight loaded, 48,500 lb. Bomb load, 6,000 lb., with some bombs on external racks. Armament, two movable cannon, four movable machine guns, one two-gun turret on top of fuselage. There is a long, under slung bombardier's gondola on the starboard side.



Dornier DO-217E

A new four-place, long-range bomber. Powered by two BMW 801, 14 cyl. twin-row radials of 1600 hp. Top speed, about 310 mph. without load. Range 1,500 mi. or more at cruising speed of 255 mph. Service ceiling, 22,490 ft. Span, 62 ft. 4 in., length, 56 ft. 5 in. Gross weight, 33,700 lb. Bomb load about 6,600 lb. Armed with two cannon in nose, two machine guns in each side, two in top rear, one in bottom rear. Has unusual umbrella diving brake. (See AVIATION, Nov., 1942, p. 154.) Later models are reported with 2000 hp. BMW 802's and a two gun turret top rear.



他們来了

"...they have come"

Here's another Northrop technique

now helping to speed U. S. warplanes abroad

BEFORE a warplane reaches the final assembly line, hundreds of small metal parts must be fastened together into wingtips, engine nacelles, tail surfaces and other sub-assemblies.

Many of the small parts in these sub-assemblies are *spot welded* one to the other, and formerly this demanded tedious one-piece-at-a-time cleaning and preparation.

Not so, any longer. Today by a new Northrop-developed technique the whole sub-assembly is fastened together by what are called "skin-tights". The job of cleaning and preparation is all done at once, in a single quick bath.

Then, still held fast together, it all goes in one piece to spot welding machines—and comes out finished.

This new Northrop development is being made available to other U.S. plane builders. So are other techniques by the Northrop group.

In return, other plane manufacturers inform Northrop of their new ways of building warplanes faster, with fewer man-hours.

And this business of trading techniques—of putting aircraft production on an "all-for-one-one-for-all" basis—is one reason that U.S. planes are now striking in such numbers on so many far-flung battle fronts. It's one reason oppressed people in many lands now look upward for deliverance — now are able to say in joy, "THEY HAVE COME!"

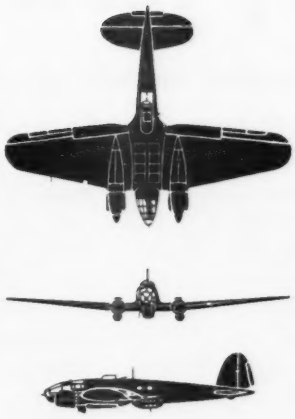
NORTHROP AIRCRAFT, Inc.

Northrop Field, Hawthorne, California

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Heinkel HE-111K

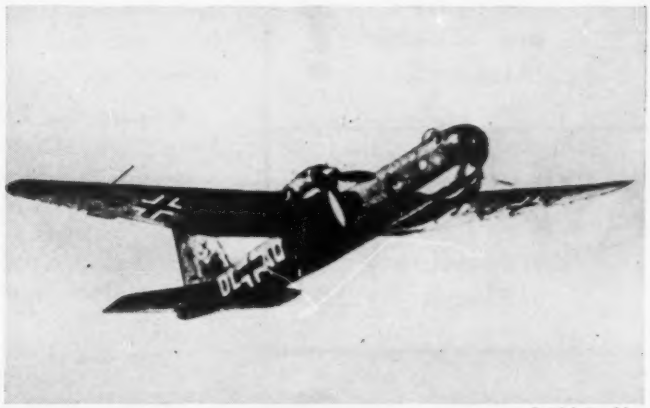
This Luftwaffe workhorse was developed from models first battle-tested in the Spanish Civil War. Powered by two Jumo 211 or Daimler Benz 601A engines, it has a top speed of approximately 275 mph. at 12,000 ft. Range runs up to 2,000 mi. with bomb loads varying from 4,000 to 5,000 lb. Armament consists of one 7.9 dorsal and two 7.9 side machine guns, operated by the same crewman; one or two ventral 7.9's or one 7.9 and a 20-mm. cannon and one or two 7.9's in the nose. Span is 74 ft. 3 in.: length is 54 ft. 6 in.



British Combine

Heinkel HE-177

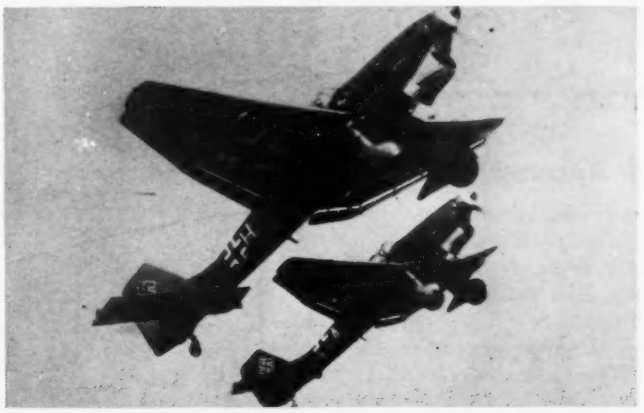
A mid-wing heavy bomber, monoplane, span, 103 ft., length, 65 ft., height, 18 ft. Loaded weight, 71,000 lb. With only two engine nacelles, there are four Mercedes-Benz DB-601, 1150 hp. liquid-cooled engines, two in each nacelle, operating two counter-rotating four blade propellers. Maximum speed, 280 mph. at 19,000 ft. Maximum range, 7,000 mi. Service ceiling, 25,000 ft. Bomb load, seven tons. Noteworthy are the forward position of pilot, bombardier's post underslung on starboard side of nose, protruding rear gunner's post.



British Combine

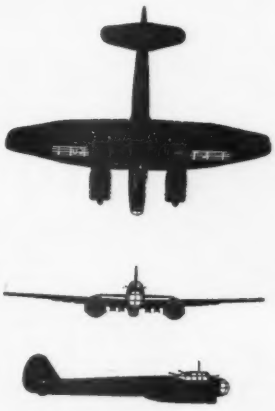
Junkers JU-87B *Stuka*

The famed two-place *Stuka* dive-bomber. Span 45 ft. 4 in., length, 35 ft. 6 in. Engine, one Jumo 211D in line 1200 hp. Top speed, 245 mph. at 13,000 ft. Diving speed, 430 mph. reduced to 245 mph. by flaps. Gross weight, 9,370 lb. Carries one 1,100-lb. bomb under fuselage, two 100-lb. or four 40-lb. bombs under wings. One machine gun in each wing-root, one flexible machine gun in rear of cabin. Weakly armed and slow, this plane operates only when the air has been cleared by more powerful fighters.



Junkers JU-88

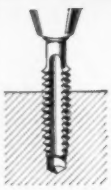
Four-place medium or dive-bomber, a two-engine ship to replace the older *Stuka*. Span, 65 ft. 7 in., length 47 ft. 1 in. Powered by two Jumo 211G1 liquid-cooled 1200 hp. engines. Top speed, 317 mph. at 15,000 ft. Cruises at 260 mph. Max. range, 2,500 mi., only 950 mi. with full load. Latest models carry 6,400-lb. load, internal and external. Total of four machine guns fire from nose, off-center "dust-bin" toward bottom rear and from top rear of greenhouse. Only one gun bears at once on any one attack-angle.



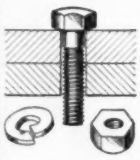
British Combine

Question every fastening job

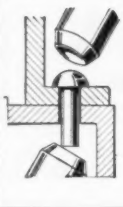
CAN YOU...



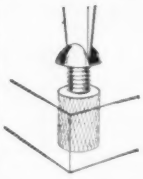
Eliminate Tapping Operations ?



Avoid Slow Bolt, Nut, and Washer Assemblies ?



Avoid Riveting and Welding in Hard-to-Reach Places ?



Eliminate Inserts in Plastics ?

Call in a P-K Assembly Engineer

to check over fastening jobs with you. He can help you search out *all* opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they'll do the job better and faster. If you prefer, mail in assembly details for recommendations.

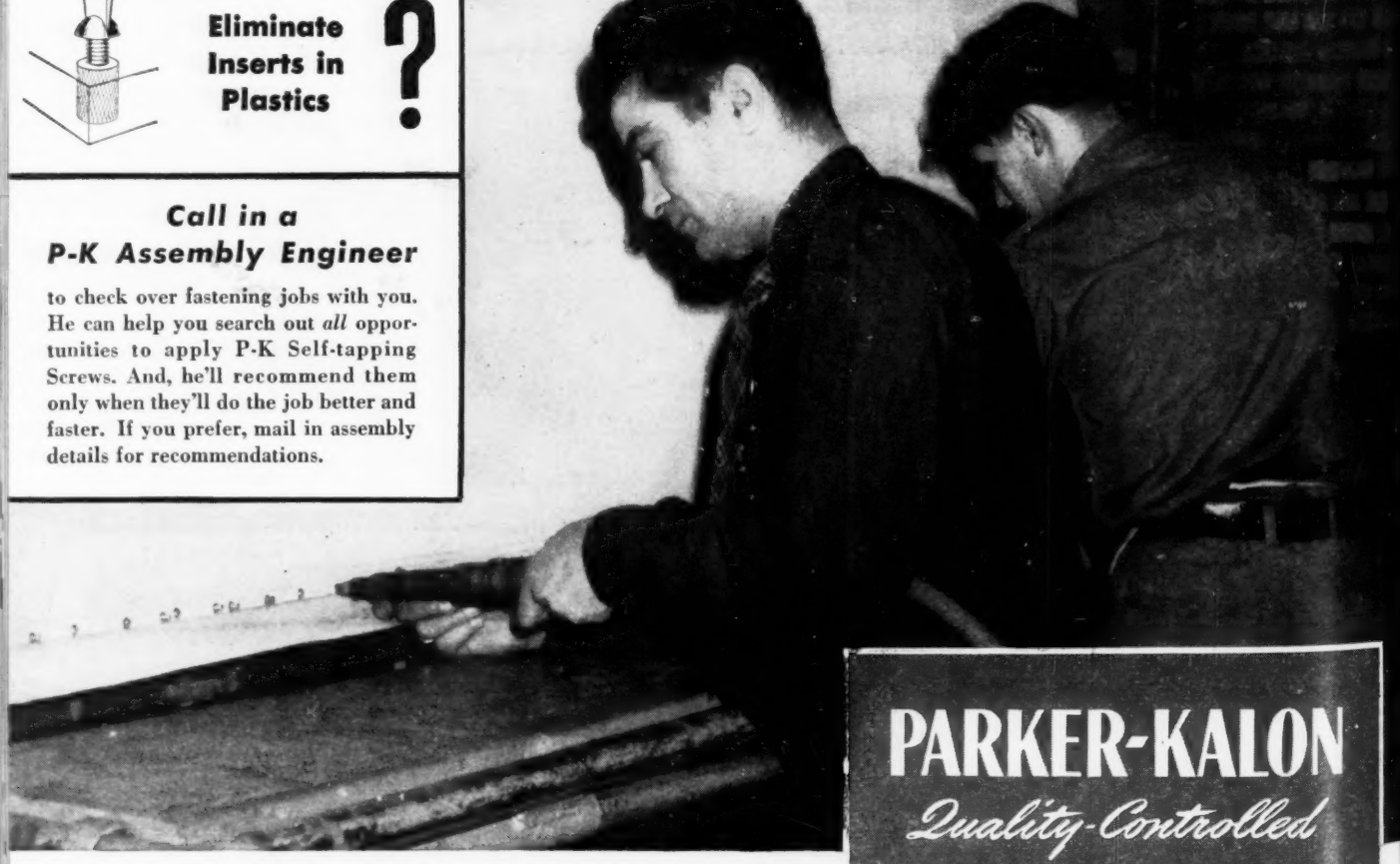
War Production needs *all* the work-hours P-K Self-tapping Screws can save

With the increasing man-power shortage, every fastening job in your plant should be suspect until you've proved beyond a doubt that it's being done by the fastest and best method possible.

Since P-K Self-tapping Screws provide greater ease, speed, and security *for a large percentage* of metal and plastic assemblies, the saving in time is of vital importance in meeting today's demand for peak production.

A Fastening Complete in One Easy Operation . . . You simply drive P-K Self-tapping Screws into plain, untapped holes. When they replace machine screws, you eliminate tapping, tap maintenance, and the problem of procuring scarce taps. When they replace bolts, you save the time consumed inserting bolts, placing washers, and running nuts. When they replace riveting and welding, expensive equipment is no longer required. When used in plastics, they end the need for costly inserts.

Change to Self-tapping Screws Overnight . . . You can make the changeover to P-K Screws with no interruption in production. No special tools or skilled help are required. Whether you are working with light or heavy steel, cast iron, aluminum, brass, or plastics . . . salvage those lost work-hours . . . question every fastening, *now!* **Parker-Kalon Corp., 192-194 Varick Street, New York, N. Y.**



SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON

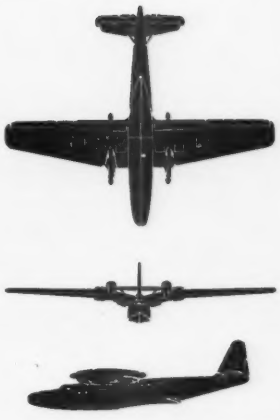
Quality-Controlled

SELF-TAPPING SCREWS

Give the Green Light to War Assemblies

Dornier DO-26

An efficient long-range flying boat. Span, 98 ft. 6 in., length, 80 ft. 6 in. Gross weight, 48,000 lb. Powered by four Jumo 205 Diesel 600 hp. engines mounted in tandem pairs. Top speed, over 200 mph. Range well over 5,000 mi. at cruising speed of 160 mph. or less. Used for long range commercial raiding and reconnaissance, can carry 1,000 lb. of bombs. Armed with one 20-mm. cannon in nose turret and two machine guns in side blisters. Originally built for trans-Atlantic mail service, it is a sound design.



Cargo Transport

Junkers JU-52

The old plug of the German Luftwaffe, tri-motor transport and bomber, originally of commercial design, but with military conversion provided for. Span, 95 ft. 11 in., length, 62 ft. Gross weight, 23,200 lb. Powered by three BMW 830 hp. 9 cyl. radials. Max. speed, 195 mph. Cruises at 170 mph. Service ceiling, 27,000 ft. Of old design, but still widely used, both in Russia and the Mediterranean. Wings are fitted with Junkers flaps, increasing lift and giving the plane higher than average ceiling.

Junkers JU-90

Four-engine troop transport of the same basic design as the JU 89 bomber. Carries crew of 3 and 40 soldiers. Span, 114 ft., length, 86 ft., 3 in. Gross weight, 50,600 lb. Engines, four BMW 880 hp. radials, or four Jumo 1150 hp. inverted V liquid-cooled. Top speed, 250 mph. at 14,000 ft. Cruising speed, 220 mph. at 14,000 ft. Service ceiling 18,000 ft. Range is over 1,000 mi. Like the JU-52, this plane has Junkers wing flaps which change the wing camber and increase lift. The outer sections act as ailerons.

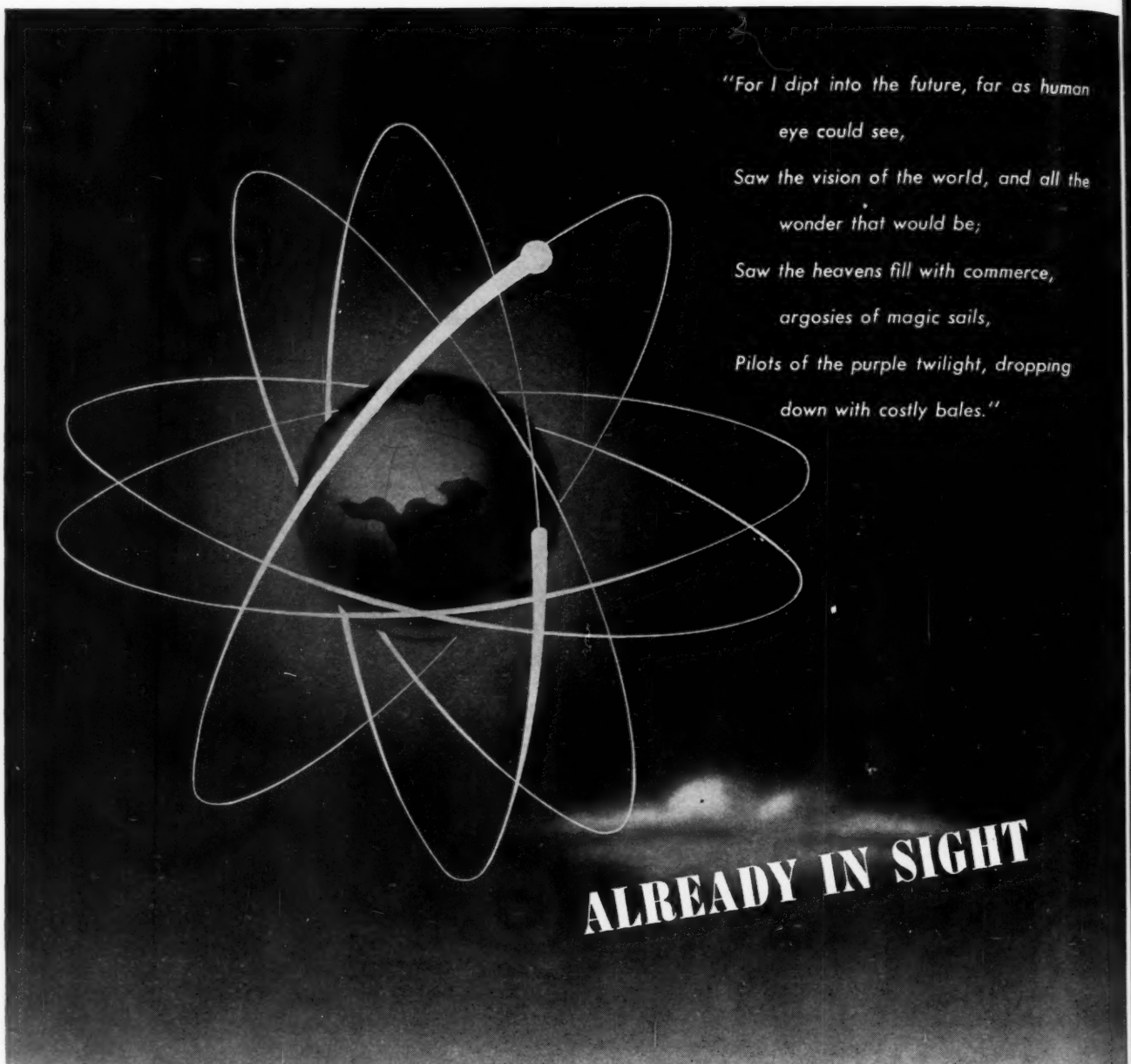
British Combine

Junkers JU-290

This is the latest large transport to come from the productive boards of the Junkers firm. It is a low-wing twin-tail monoplane. Driven by four Bramo *Fafnir* 323, 1000 hp. radial engines, top speed is about 250 mph. Span is about 120 ft. Although no photograph is available, a close idea may be obtained from the silhouettes. High tail planes and rudders make it suitable for parachute troops, but it is not known to have been used for this purpose as yet.

Blohm and Voss BV-222

A large, six-engine high-wing monoplane flying boat, with single tail. Span, 150 ft., length, 112 ft. Powered by six BMW 132 Dc 1000 hp. in line, liquid-cooled engines. Top speed, 199 mph. at 9,840 ft. Weight loaded, 100,000 lb. Armament is said to include gun turrets in nose and tail. This ship was designed just before the war for projected trans-Atlantic service. As can be seen from the silhouette, the hull is long and slim, like many other German planes. Wings have dihedral as far as the outboard engines, then are straight, giving a drooped appearance. Hull is two-stepped. There is a glass-enclosed gun position in the tail.


"For I dipt into the future, far as human eye could see,
Saw the vision of the world, and all the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales."
ALREADY IN SIGHT

Tennyson's prophetic vision, more than half a century ago, is just over tomorrow's horizon. Far beyond the reaches of his poetic imagination are the marvels planned for the post-war world by aviation and radio engineers.

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Although practically 100% of our business today is in the high-priority, war-essential category, our thinking is unrestricted. We will be happy to work with you on "futures." May we help to develop your post-war ideas and plans?

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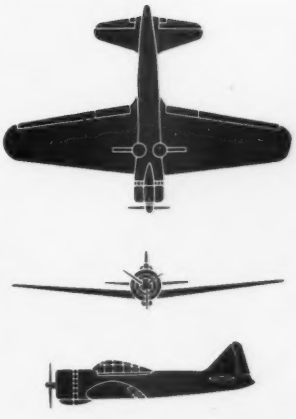
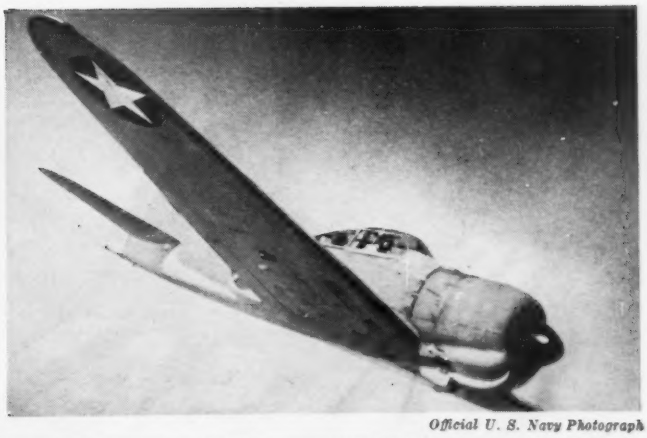
Fighters

Mitsubishi Zero

Single-place fighter, Japan's most talked-of airplane. Span 39 ft. 5 in., length, 28 ft. 5 in. Weight, about 5,140 lb. Engine, one Junkers 800 hp. or the *Kinsei* 14-cyl. radial of about 1000 hp. The latter is a combination of our Pratt and Whitney and Wright engines, together with some features "lifted" from English designs. Top speeds up to 350 mph. at 10,000 ft. Service ceiling about 36,000 ft. Armed with two 20-mm. cannon in wings, two 7.7 mm. cal. machine guns in cowl. Light weight, maneuverability and climbing power characterize this fighter. Durability is poor, firepower not heavy.

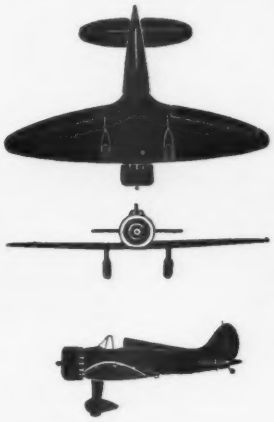




Official U. S. Navy Photograph

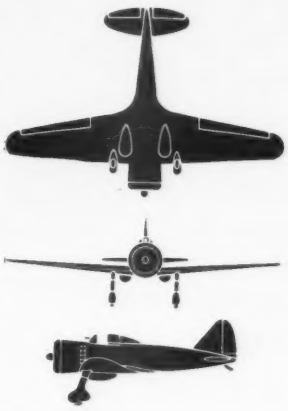
Mitsubishi 96 Fighter

This is labeled a Navy fighter, although all these types are used by both Army and Navy. Span, 36 ft., length, 24 ft. 6 in. Gross weight, 4,300 lb. Powered by one *Kinsei* 730 hp. 9-cyl. radial engine. Max. speed, 250 mph. at 9,000 ft. Service ceiling, 31,000 ft. Range, 440 mi. Armed with two synchronized machine guns and probably two other 7.7-mm. guns in wings. Landing gear is fixed and spatted, although this and other types are encountered with retracting wheels, closed cockpits and larger engines.



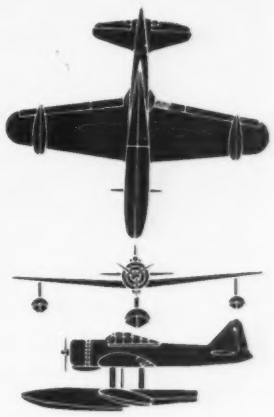
Mitsubishi 97 Fighter

Single-place, Army and Navy fighter, a development of the 96, and almost identical, except that later models have retractable landing gear. Span slightly larger, 40 ft., length, 25 ft. Weight, 4,500 lb., slight extra weight probably due to retracting gear. Engine, one *Kinsei* 730 hp. radial. Top speed, 265 mph. Cruising, 225 mph. Service ceiling, 30,000 ft. Range, 590 mi. Controllable pitch propellers, which are exact copies of the Hamilton Standard, are fitted to both this and the 96 fighter. Armament about the same.



Mitsubishi Zero Floatplane

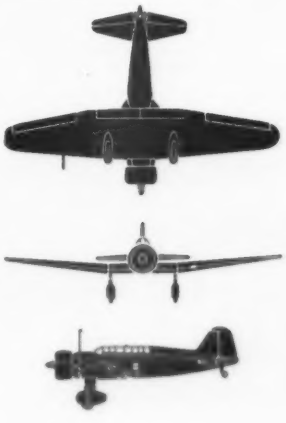
The Navy conversion of the *Zero*. Dimensions identical with the Army model. Span, 39 ft. 5 in., length, 28 ft. 5 in. No picture is available but the silhouette shows a single float, with wing floats, probably fixed. Performance figures naturally, are not as good in this model. Of all the U. S. pilots recently interviewed, all agreed that they would like to fly the Zero, but would rather fight in American-built planes because of greater protection, rugged construction and heavier firepower.



Bombers

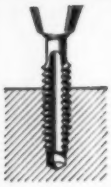
Mitsubishi 98 *Karigane*

A two-place light bomber and reconnaissance plane, almost identical to the Mitsubishi 104 except for variations in tail fin, cowling and engine. The *Karigane* has one Mitsubishi A 14-cyl. 800 hp. engine. Top speed 310 mph., cruising speed, 200 mph. Range, 1,500 mi. Span, 39 ft. 5 in., length, 28 ft. Gross weight, 5,060 lb. An early model, the *Divine Wind*, flew from Tokyo to London in 94½ hr. in 1937, a distance of 9,560 mi. A Hamilton propeller was used. This ship is much lighter than the Mitsubishi 104.



Question every fastening job

CAN YOU...



Eliminate Tapping Operations ?

Avoid Slow Bolt, Nut, and Washer Assemblies ?

Avoid Riveting and Welding in Hard-to-Reach Places ?

Eliminate Inserts in Plastics ?

Call in a P-K Assembly Engineer

to check over fastening jobs with you. He can help you search out *all* opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they'll do the job better and faster. If you prefer, mail in assembly details for recommendations.

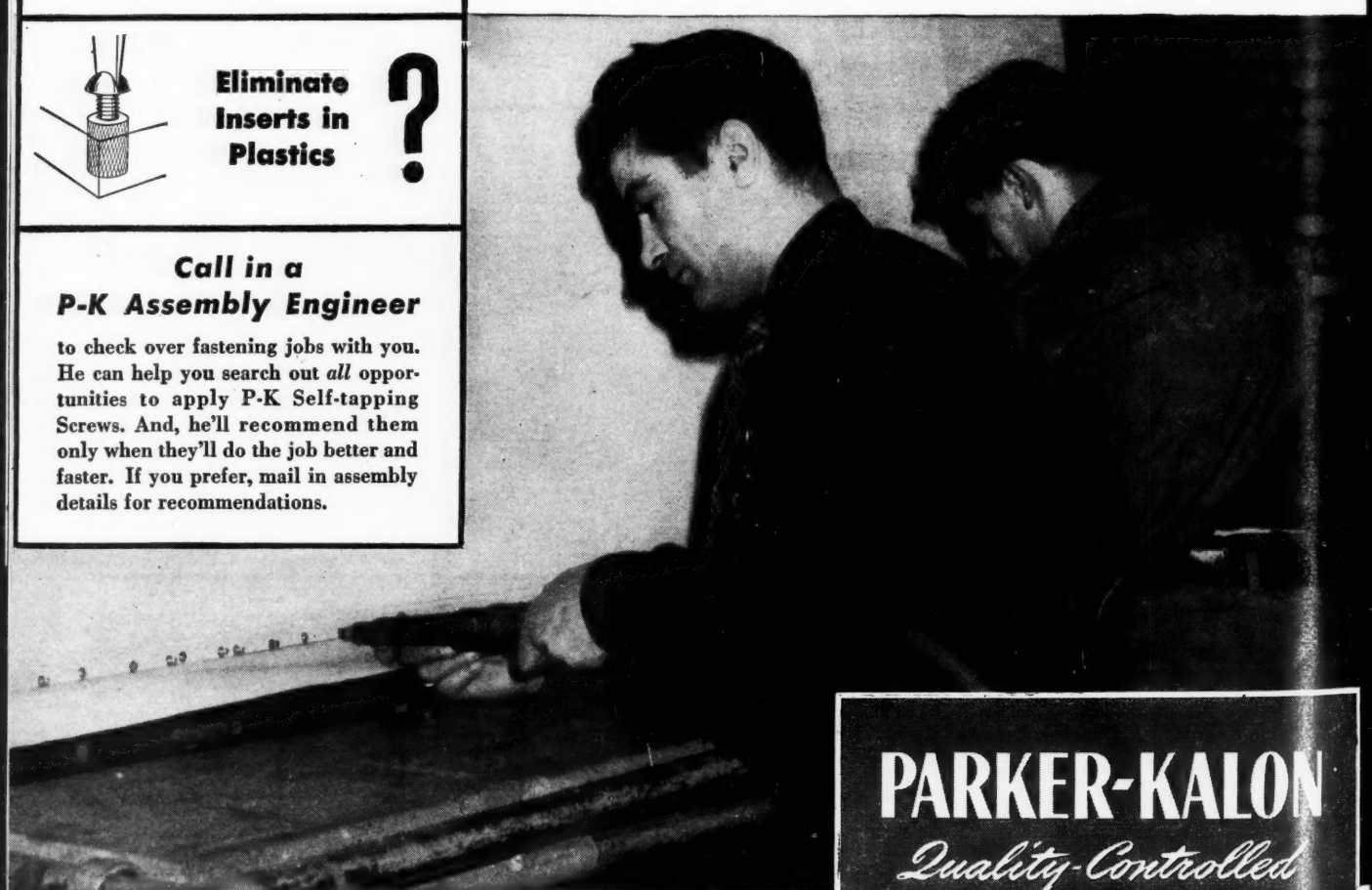
War Production needs *all* the work-hours P-K Self-tapping Screws can save

With the increasing man-power shortage, every fastening job in your plant should be suspect until you've proved beyond a doubt that it's being done by the fastest and best method possible.

Since P-K Self-tapping Screws provide greater ease, speed, and security *for a large percentage* of metal and plastic assemblies, the saving in time is of vital importance in meeting today's demand for peak production.

A Fastening Complete in One Easy Operation . . . You simply drive P-K Self-tapping Screws into plain, untapped holes. When they replace machine screws, you eliminate tapping, tap maintenance, and the problem of procuring scarce taps. When they replace bolts, you save the time consumed inserting bolts, placing washers, and running nuts. When they replace riveting and welding, expensive equipment is no longer required. When used in plastics, they end the need for costly inserts.

Change to Self-tapping Screws Overnight . . . You can make the changeover to P-K Screws with no interruption in production. No special tools or skilled help are required. Whether you are working with light or heavy steel, cast iron, aluminum, brass, or plastics . . . salvage those lost work-hours . . . question every fastening, *now!* **Parker-Kalon Corp., 192-194 Varick Street, New York, N. Y.**



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SELF-TAPPING SCREWS

Give the Green Light to War Assemblies

Dornier DO-26

An efficient long-range flying boat. Span, 88 ft. 6 in., length, 80 ft. 6 in. Gross weight, 48,000 lb. Powered by four Jumo 205 Diesel 600 hp. engines mounted in tandem pairs. Top speed, over 200 mph. Range well over 5,000 mi. at cruising speed of 160 mph. or less. Used for long range commercial raiding and reconnaissance, can carry 1,000 lb. of bombs. Armed with one 20-mm. cannon in nose turret and two machine guns in side blisters. Originally built for trans-Atlantic mail service, it is a sound design.

Cargo Transport

Junkers JU-52

The old plug of the German Luftwaffe, tri-motor transport and bomber, originally of commercial design, but with military conversion provided for. Span, 95 ft. 11 in., length, 62 ft. Gross weight, 23,200 lb. Powered by three BMW 830 hp. 9 cyl. radials. Max. speed, 195 mph. Cruises at 170 mph. Service ceiling, 27,000 ft. Of old design, but still widely used, both in Russia and the Mediterranean. Wings are fitted with Junkers flaps, increasing lift and giving the plane higher than average ceiling.

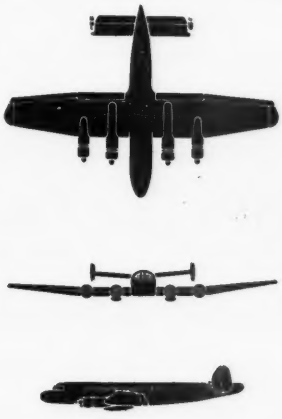
Junkers JU-90

Four-engine troop transport of the same basic design as the JU 89 bomber. Carries crew of 3 and 40 soldiers. Span, 114 ft., length, 86 ft., 3 in. Gross weight, 50,600 lb. Engines, four BMW 880 hp. radials, or four Jumo 1150 hp. inverted V liquid-cooled. Top speed, 250 mph. at 14,000 ft. Cruising speed, 220 mph. at 14,000 ft. Service ceiling 18,000 ft. Range is over 1,000 mi. Like the JU-52, this plane has Junkers wing flaps which change the wing camber and increase lift. The outer sections act as ailerons.

British Combine

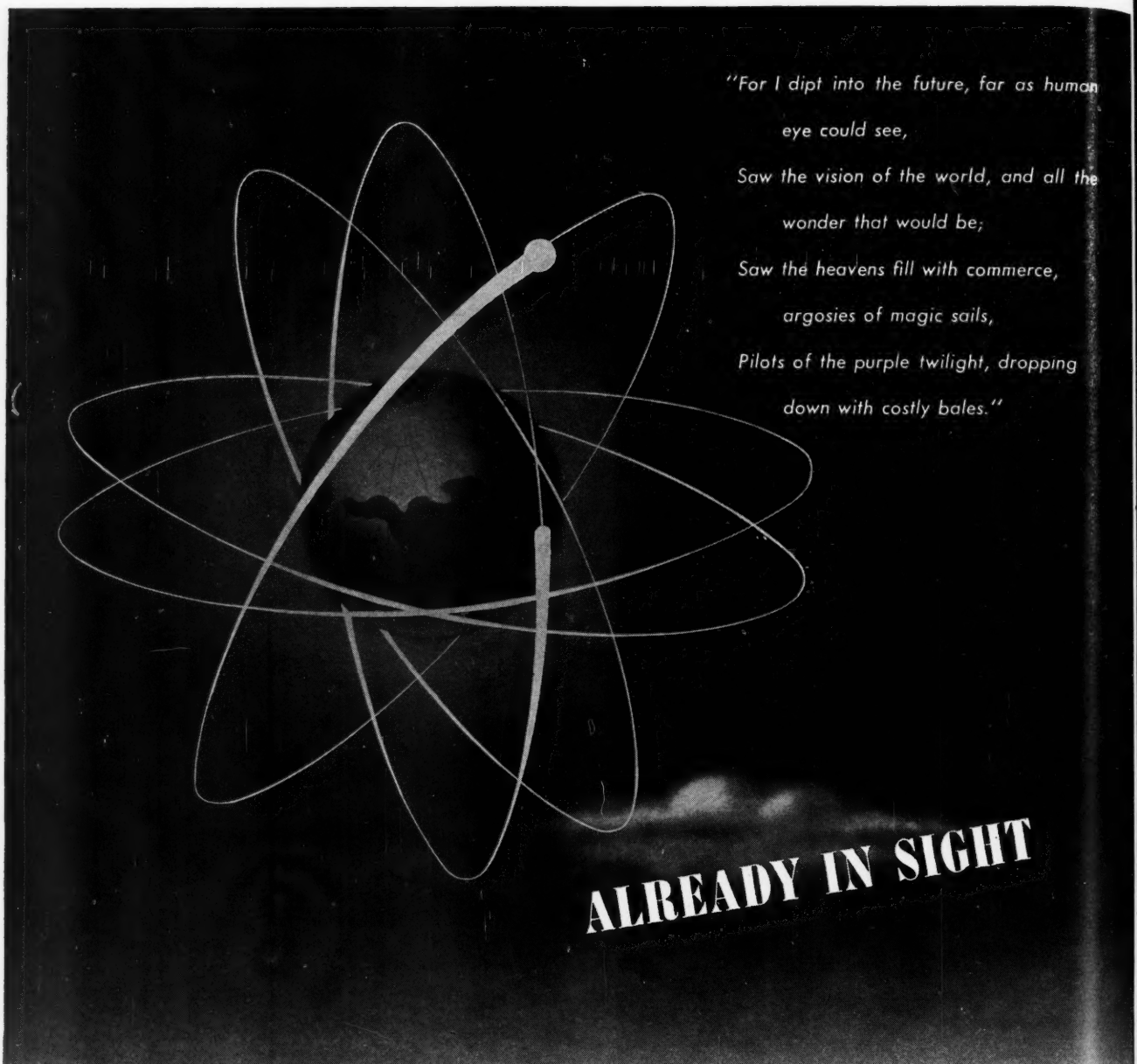
Junkers JU-290

This is the latest large transport to come from the productive boards of the Junkers firm. It is a low-wing twin-tail monoplane. Driven by four Bramo *Fafnir* 323, 1000 hp. radial engines, top speed is about 250 mph. Span is about 120 ft. Although no photograph is available, a close idea may be obtained from the silhouettes. High tail planes and rudders make it suitable for parachute troops, but it is not known to have been used for this purpose as yet.



Blohm and Voss BV-222

A large, six-engine high-wing monoplane flying boat, with single tail. Span, 150 ft., length, 112 ft. Powered by six BMW 132 Dc 1000 hp. in line, liquid-cooled engines. Top speed, 199 mph. at 9,840 ft. Weight loaded, 100,000 lb. Armament is said to include gun turrets in nose and tail. This ship was designed just before the war for projected trans-Atlantic service. As can be seen from the silhouette, the hull is long and slim, like many other German planes. Wings have dihedral as far as the outboard engines, then are straight, giving a drooped appearance. Hull is two-stepped. There is a glass-enclosed gun position in the tail.


"For I dipt into the future, far as human
eye could see,
Saw the vision of the world, and all the
wonder that would be;
Saw the heavens fill with commerce,
argosies of magic sails,
Pilots of the purple twilight, dropping
down with costly bales."
ALREADY IN SIGHT

Tennyson's prophetic vision, more than half a century ago, is just over tomorrow's horizon. Far beyond the reaches of his poetic imagination are the marvels planned for the post-war world by aviation and radio engineers.

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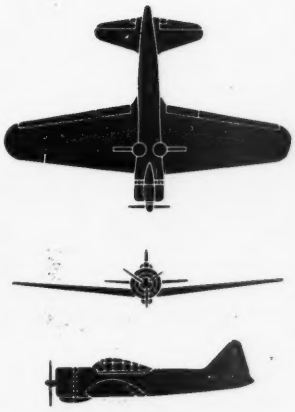
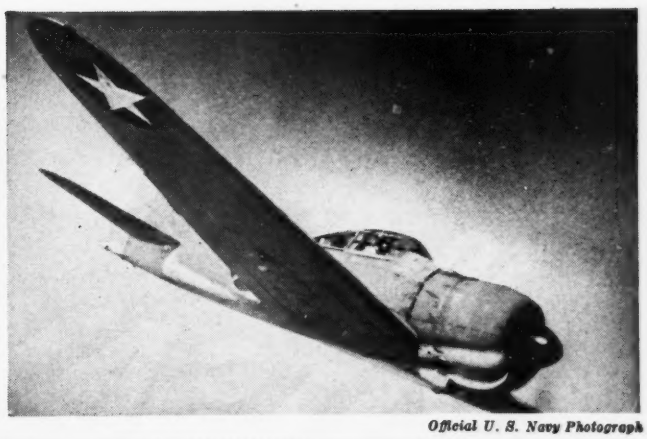
Fighters

Mitsubishi Zero

Single-place fighter, Japan's most talked-of airplane. Span 39 ft. 5 in., length, 28 ft. 5 in. Weight, about 5,140 lb. Engine, one Junkers 800 hp. or the *Kinsei* 14-cyl. radial of about 1000 hp. The latter is a combination of our Pratt and Whitney and Wright engines, together with some features "lifted" from English designs. Top speeds up to 350 mph. at 10,000 ft. Service ceiling about 36,000 ft. Armed with two 20-mm. cannon in wings, two 7.7 mm. cal. machine guns in cowl. Light weight, maneuverability and climbing power characterize this fighter. Durability is poor, firepower not heavy.

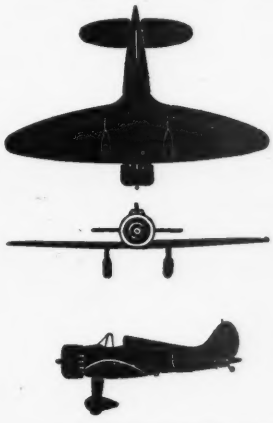




Official U. S. Navy Photograph

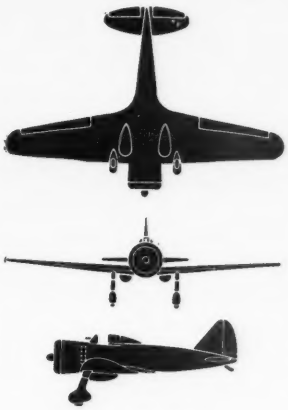
Mitsubishi 96 Fighter

This is labeled a Navy fighter, although all these types are used by both Army and Navy. Span, 36 ft., length, 24 ft. 6 in. Gross weight, 4,300 lb. Powered by one *Kinsei* 730 hp. 9-cyl. radial engine. Max. speed, 250 mph. at 9,000 ft. Service ceiling, 31,000 ft. Range, 440 mi. Armed with two synchronized machine guns and probably two other 7.7-mm. guns in wings. Landing gear is fixed and spatted, although this and other types are encountered with retracting wheels, closed cockpits and larger engines.



Mitsubishi 97 Fighter

Single-place, Army and Navy fighter, a development of the 96, and almost identical, except that later models have retractable landing gear. Span slightly larger, 40 ft., length, 25 ft. Weight, 4,500 lb., slight extra weight probably due to retracting gear. Engine, one *Kinsei* 730 hp. radial. Top speed, 265 mph. Cruising, 225 mph. Service ceiling, 30,000 ft. Range, 590 mi. Controllable pitch propellers, which are exact copies of the Hamilton Standard, are fitted to both this and the 96 fighter. Armament about the same.



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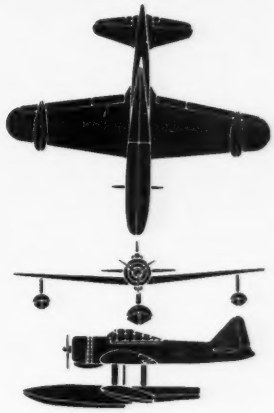

Bombers

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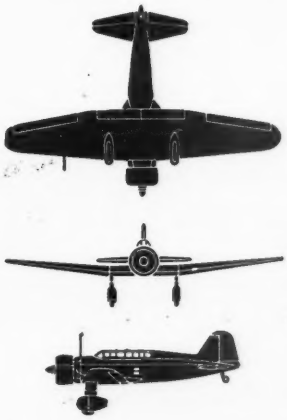

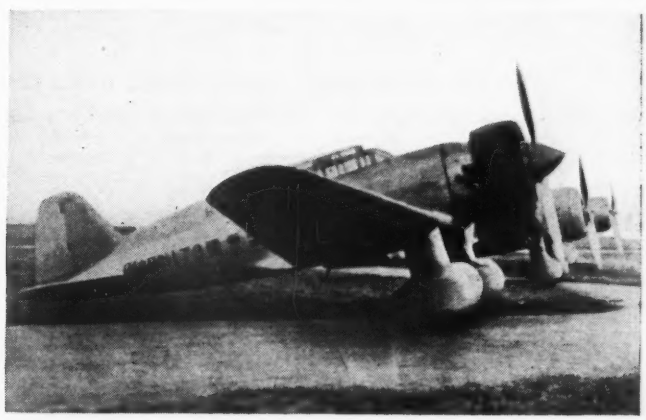

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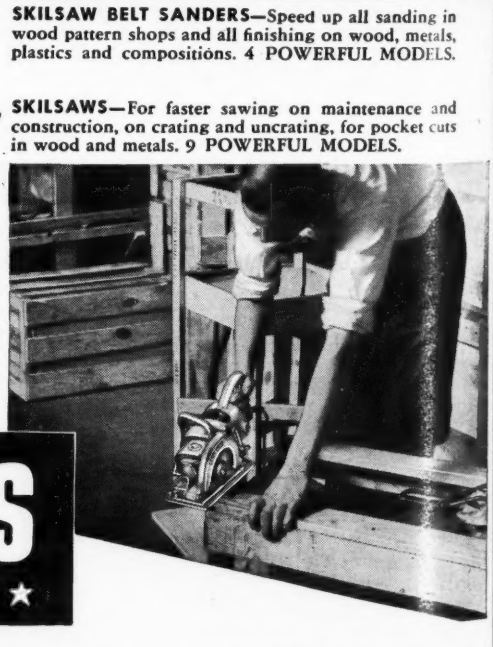

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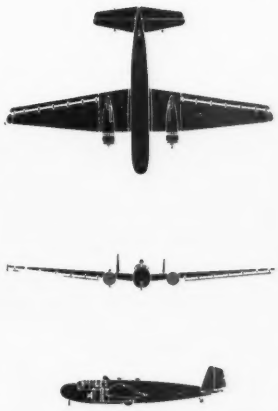
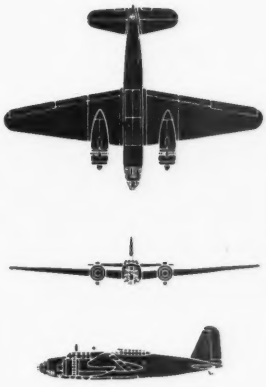
Mitsubishi 96 Bomber

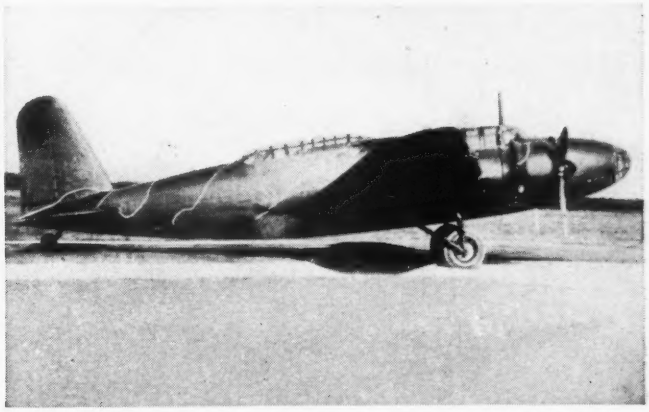
A two-engine, 7-place, heavy bomber. Span, 82 ft., length, 54 ft. Gross weight, 22,000 lb. Engines, two Mitsubishi *Kinsei IV* 14-cyl. radials, 900-1000 hp. Top speed, 230 mph. at 10,000 ft. Range with load of 2,200 lb., 950 mi. Armed with two 7.7-mm. machine guns in wings, one 20mm. cannon in upper turret, two machine guns laterally, one fixed in tail. Service ceiling is 24,000 ft. The wings are fitted with Junkers flaps. Landing gear is retractable. This plane is also used as a freight carrier.



Mitsubishi 97 Bomber

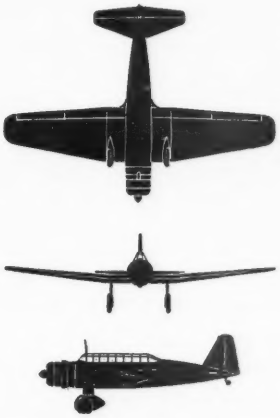
A twin-engine reconnaissance bomber, similar to the 96, but with slightly longer range. Span, 73 ft., length, 62 ft. Gross weight, 22,000 lb. Powered by two Mitsubishi *Kinsei IV* 14 cyl. radials of 870 hp. Max. speed, 220 mph. Cruising speed, 190 mph. Service ceiling, 22,000 ft. Range, 1,800 mi. with bomb load of 4,400 lb. Armed with two 7.7-mm. machine guns in nose, two in dorsal turret, two firing laterally, one fixed machine gun in tail. Equipped with Mitsubishi-Hamilton three-blade propellers.

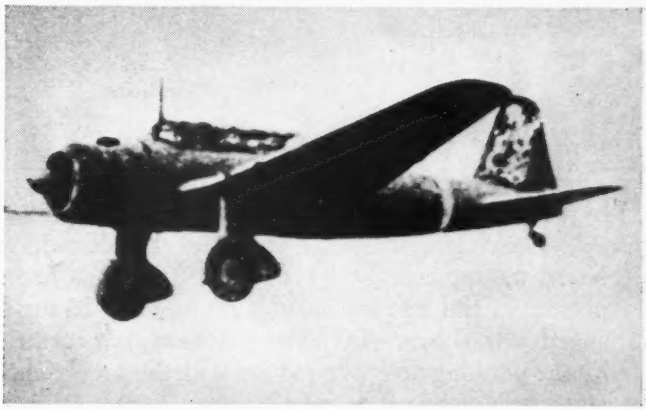




Mitsubishi 98 Bomber

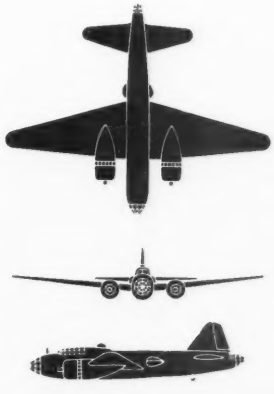
Another two-place, light bomber-reconnaissance plane. All metal, fixed landing gear, wheel spats open at sides. Engine, one Mitsubishi. *Kinsei IV* 14 cyl. 900 hp. radial. Top speed, 250 mph. at 11,000 ft. Cruising speed, 208 mph. Max. range, 280 mi. with bomb load of 1,230 lb. It is larger and heavier than the *Karigane*, with a span of 46 ft., length of 26 ft. 2 in., and a gross weight of 7,800 lb. Armament two 7.7-mm, machine guns in fuselage or two 20-mm. cannon in wings, two flexible machine guns in rear of cockpit.





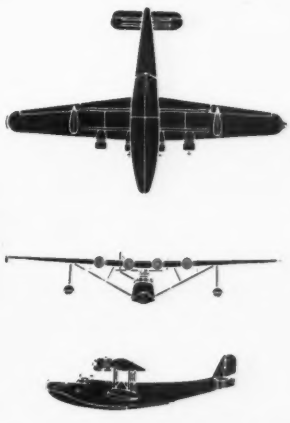
Type One Bomber

This is Japan's latest medium bomber. Like most of her others, it is a composite of the best American, British, and European types. No good picture is to be had, and no detailed information is available. From the silhouette it appears to be a capable, well armed ship.



Type 97 Flying Boat

A four-engine flying boat, of the *Kawanishi* type, also showing some Sikorsky influence. Span is 131 ft., length 82 ft., height, 20 ft. Gross weight, 45,000 lb. Engines are four Mitsubishi *Kinsei* 4C 900 hp. radials. Top speed, about 190 mph. Service ceiling, about 20,000 ft. Range, 18,000 mi. Earlier models had no gun turrets, later ones two, in nose and tail. The latter does not protrude beyond the tail fins, necessarily limiting the horizontal arc of fire. It carries a crew of six to ten men.



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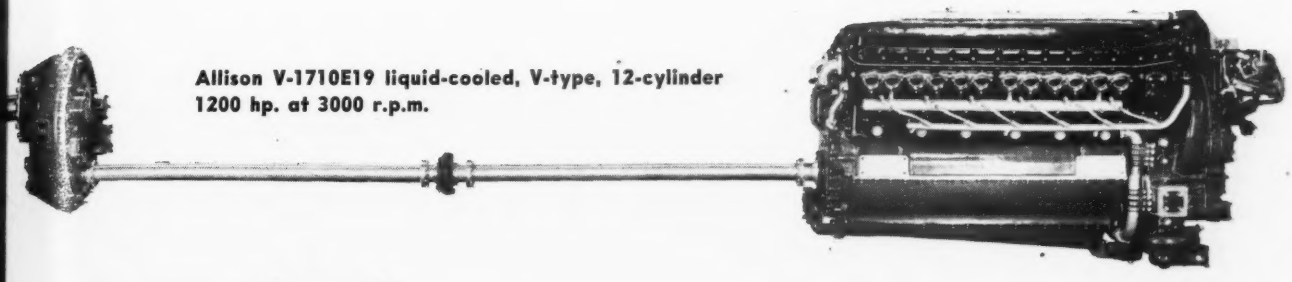
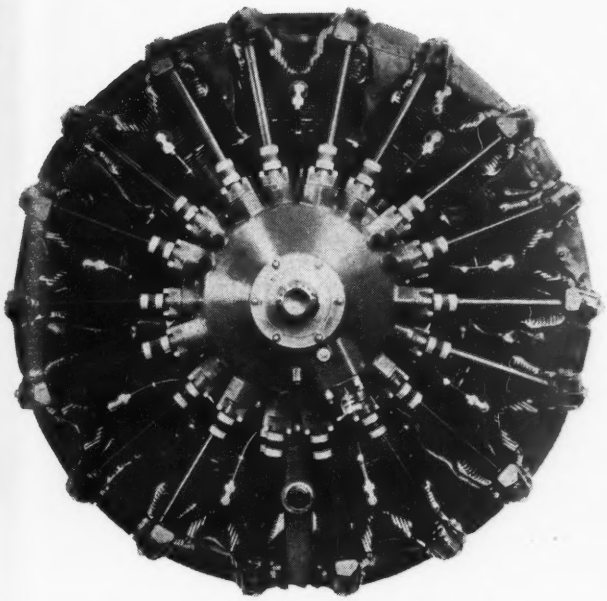
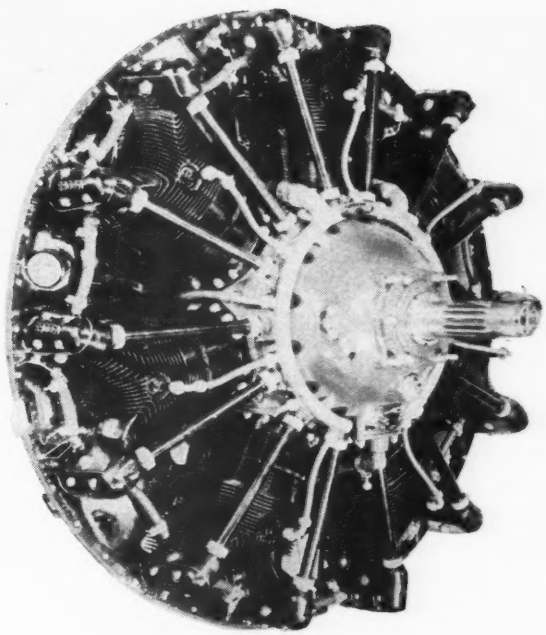


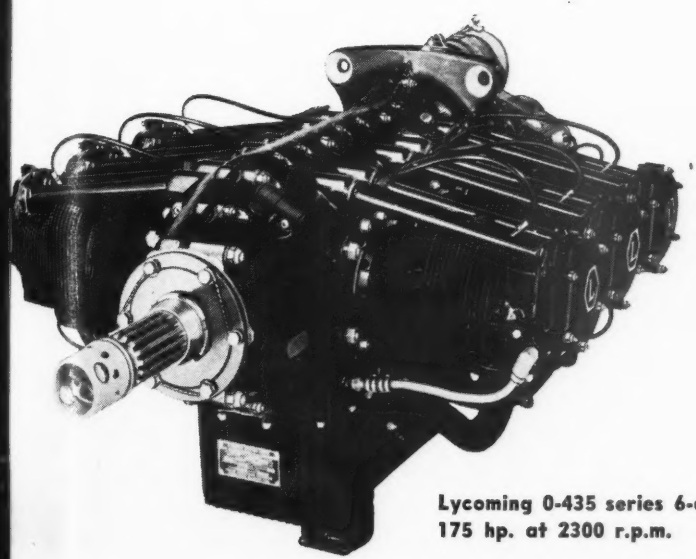
Allison V-1710E19 liquid-cooled, V-type, 12-cylinder
1200 hp. at 3000 r.p.m.



Lycoming R-680-E3A 9-cylinder radial
300 hp. at 2300 r.p.m.



Jacobs 7-cylinder radial
300 hp. at 2100 r.p.m.



Lycoming 0-435 series 6-cylinder opposed
175 hp. at 2300 r.p.m.

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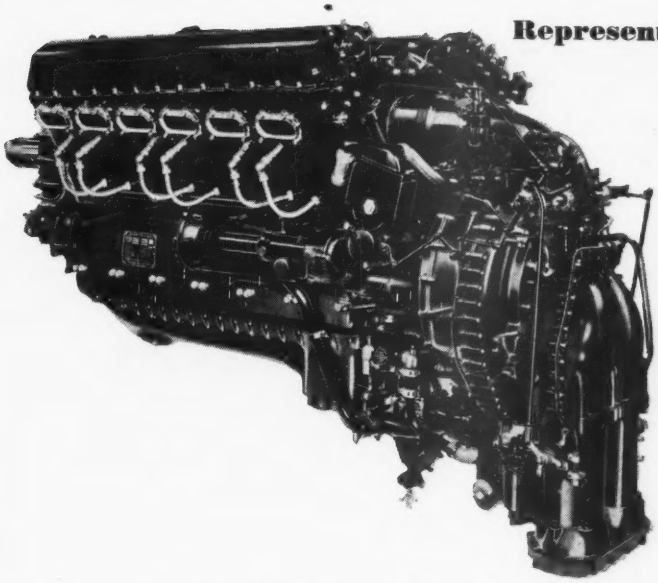
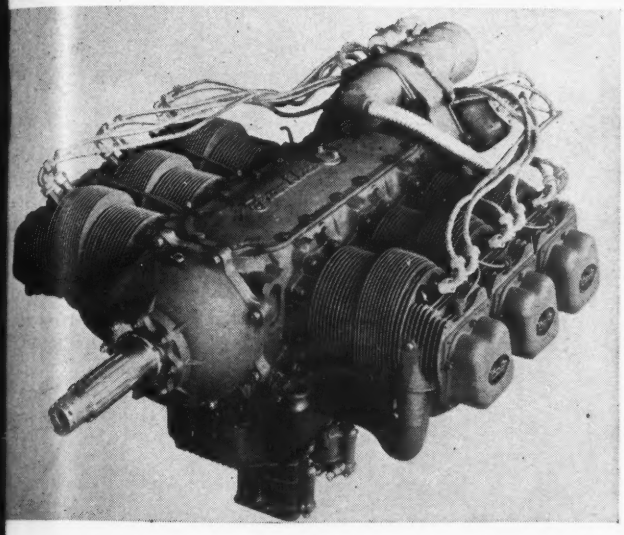
DELCO MOTORS

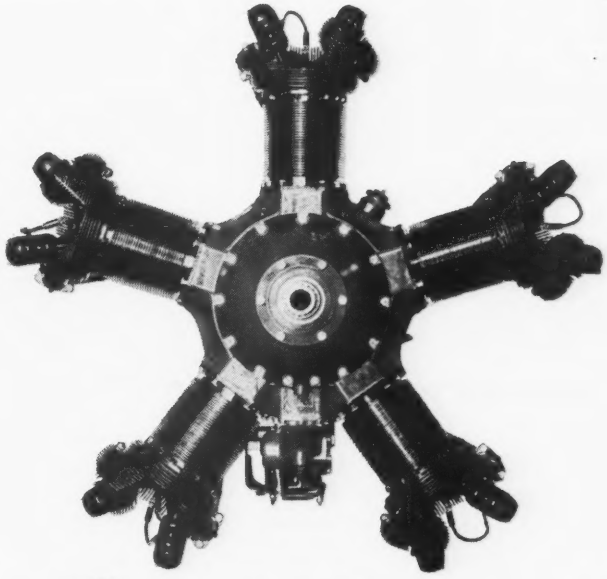
DIVISION OF GENERAL DELCO PRODUCTS DAYTON, OHIO MOTORS CORPORATION



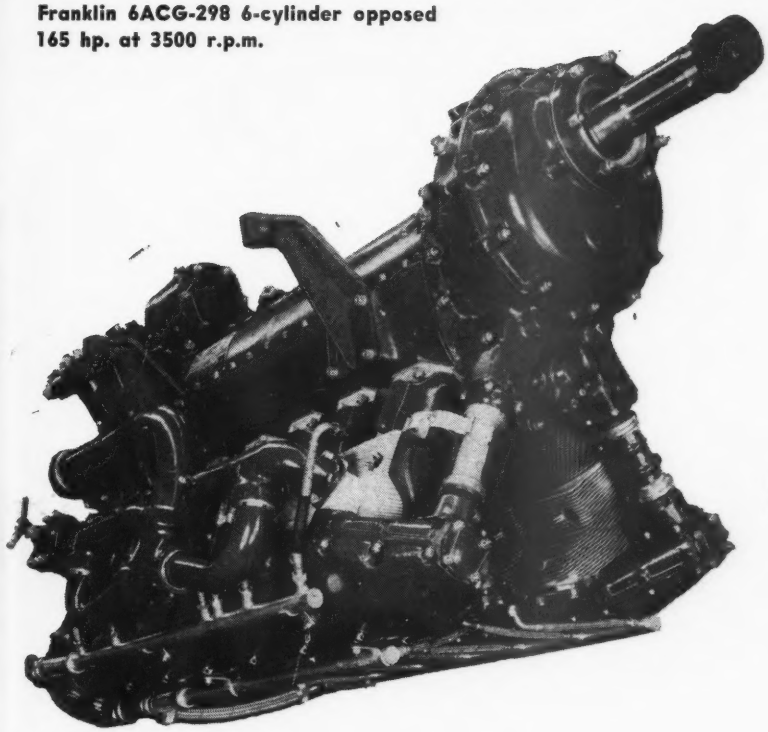
Packard Rolls-Royce V-1650 liquid-cooled, 12-cylinder V-type
1080 hp. at 2650 r.p.m.



Franklin 6ACG-298 6-cylinder opposed
165 hp. at 3500 r.p.m.

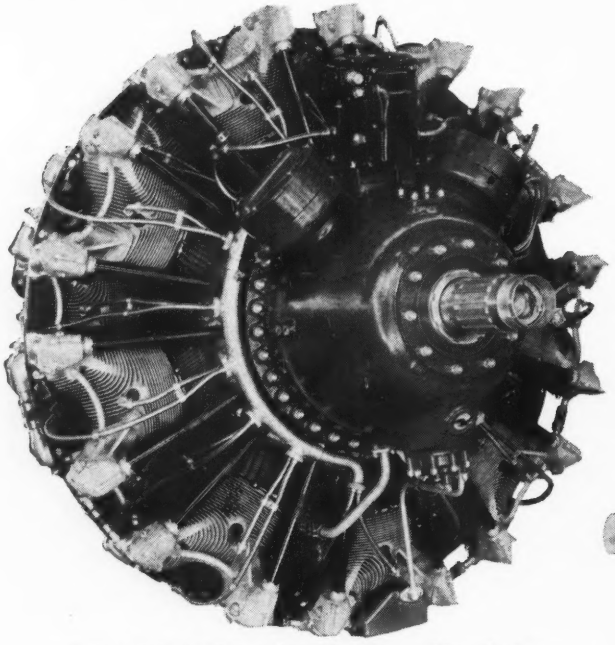


Kinner R-55 5-cylinder radial
175 hp. at 2100 r.p.m.

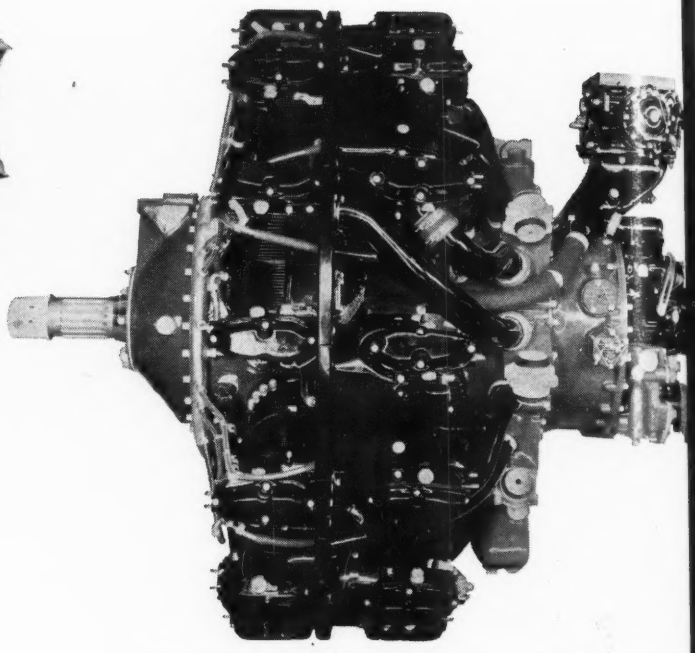


Ranger 12-cylinder inverted V, aircooled
520 hp. at take-off.

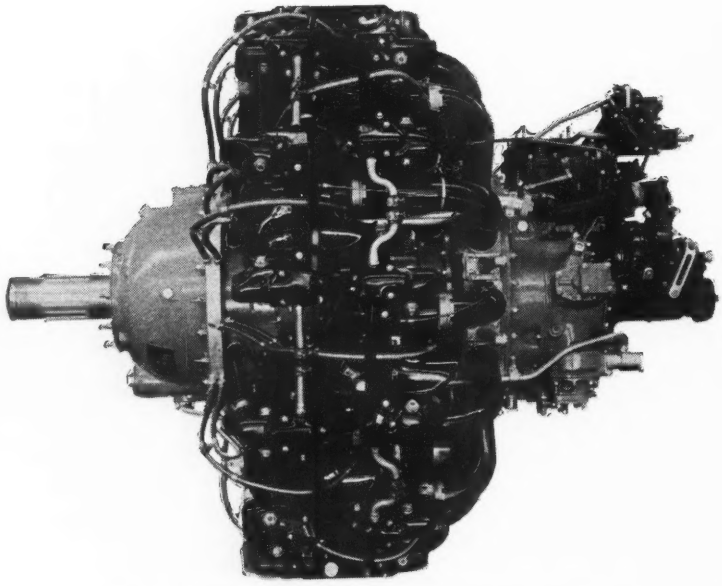
Representative Aircraft Engines for 1943



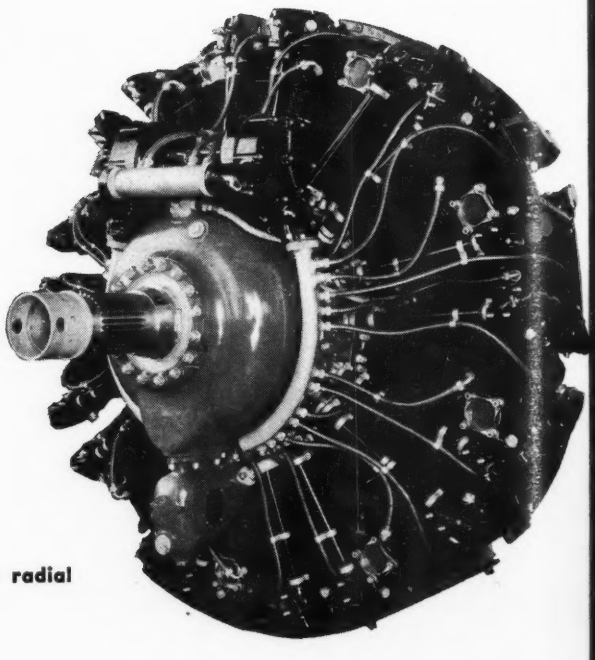
Pratt and Whitney Double Wasp 18-cylinder
2000 hp.



Wright Cyclone GR2600 series 14-cylinder twin-row rad
1600 hp. at 2400 r.p.m.



Pratt and Whitney Twin Wasp Jr. 14-cylinder radial
1100 hp. at 2550 r.p.m.



Wright Cyclone 18-cylinder twin-row radial
2000 hp.

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AVIATION PRODUCTS

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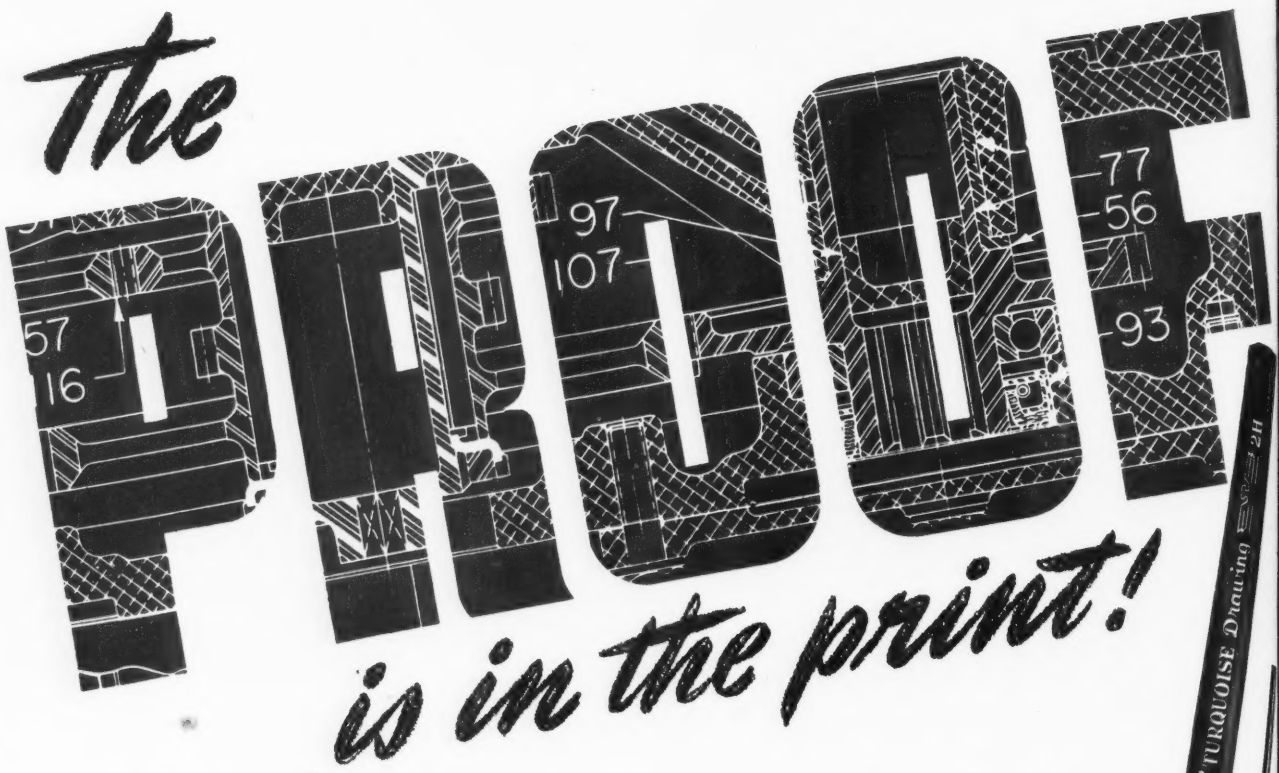

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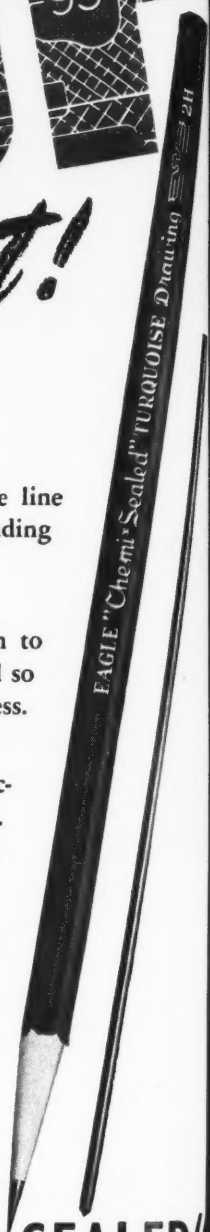

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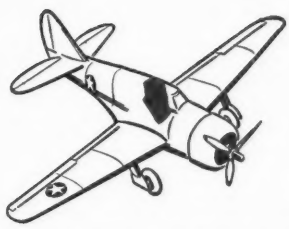

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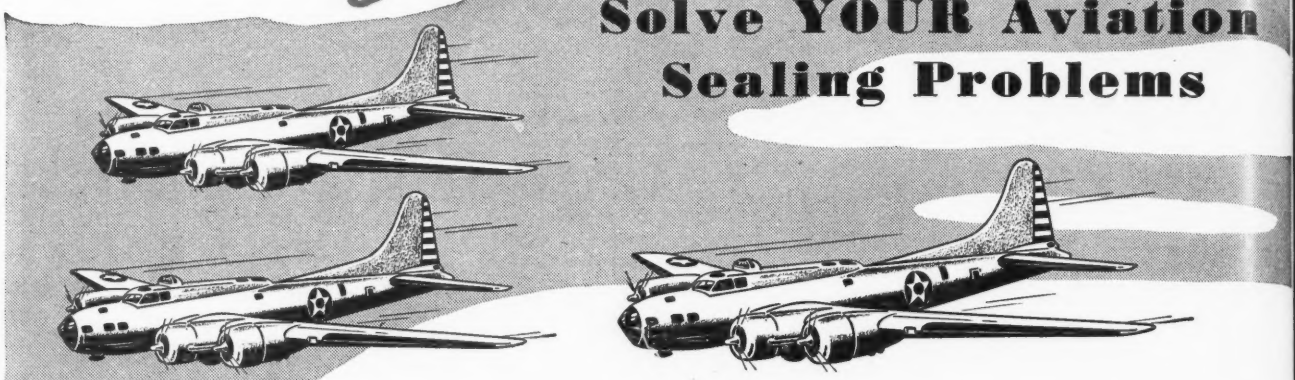

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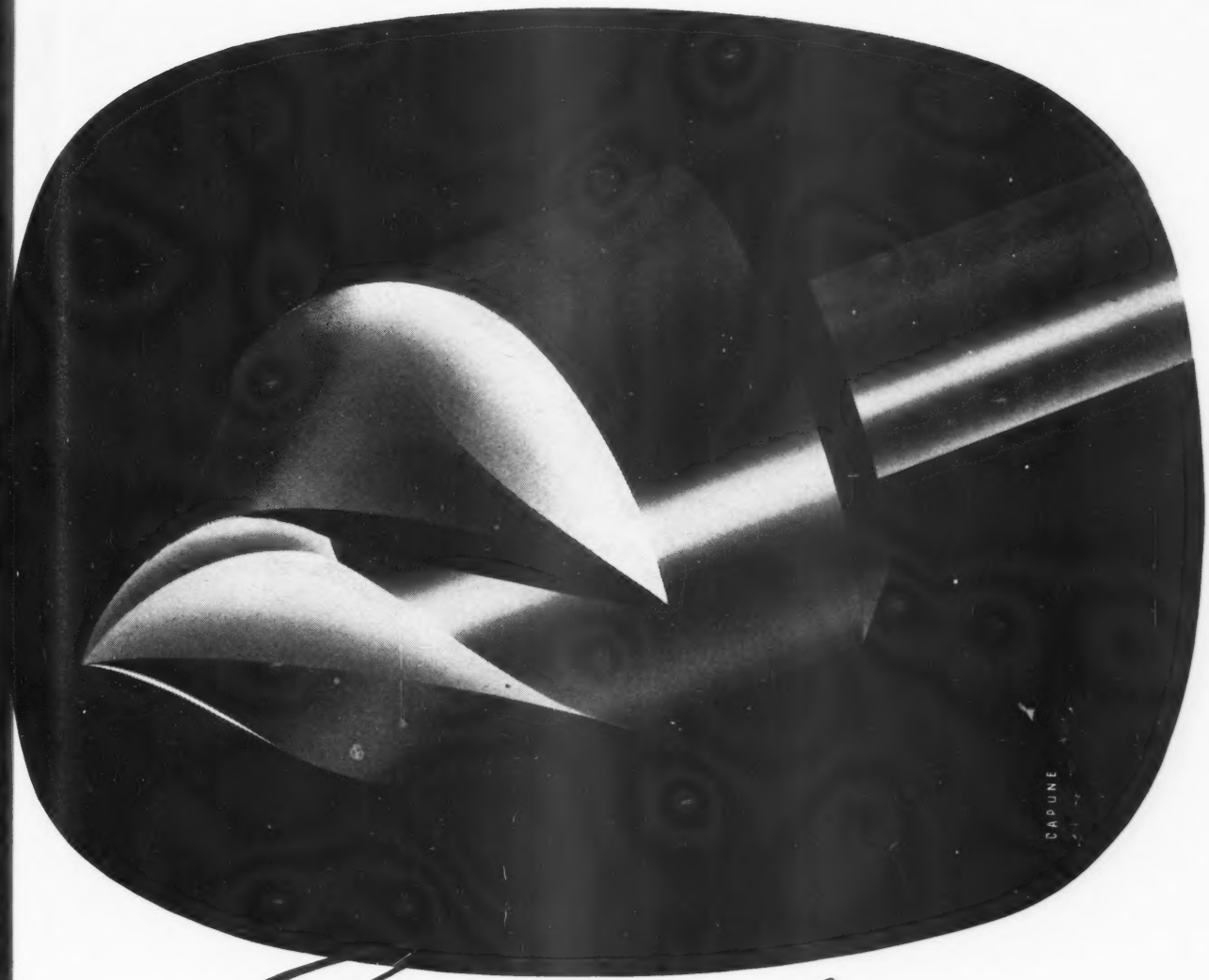

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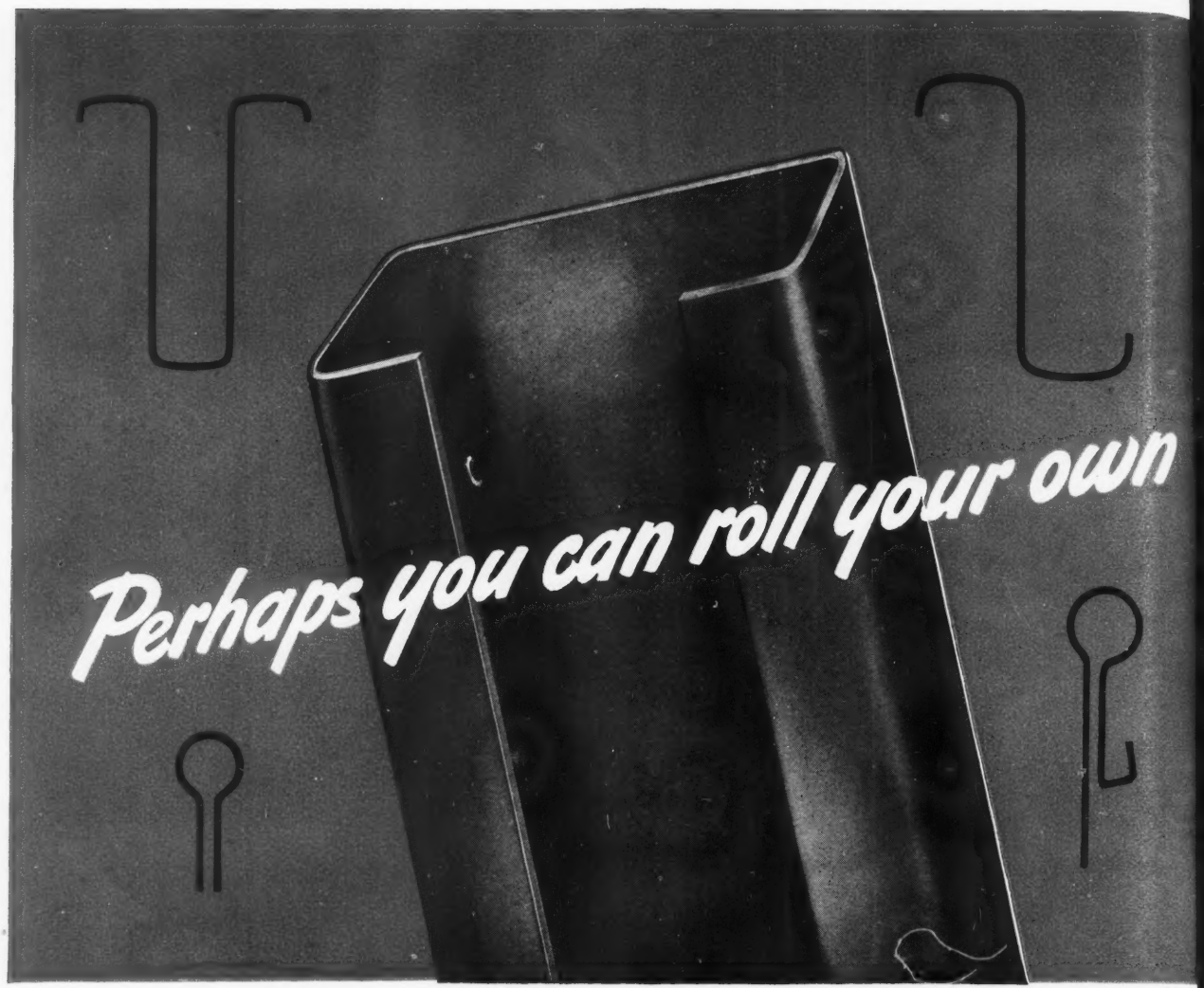

This shape is rolled from Alcoa Aluminum Alloy sheet in a single operation. Its use may take the place of a thicker extruded shape, thereby releasing metal and extrusion presses for production of vital war materials. Its producer is one of many companies who are roll-forming similar Aluminum-sheet shapes.

Many of these rolled-sheet shapes, being produced today for war products, are made of heat-treated Aluminum alloys to give them high strength. Often, the "as-rolled temper" strip is fed right from the heat-treating furnace to the forming rolls, before the metal can age-harden, thus avoiding distortion that might occur if heat treatment followed forming.

Also shown above, in silhouette, are other rolled-sheet shapes. It doesn't take much stretching of the imagination to visualize a great variety of these Aluminum shapes used in numerous products. Exactly the right thickness and shape for strength and stiffness, but no more metal than is actually needed.

The economies possible with large quantity production are certain to cause these Aluminum rolled-sheet shapes to be adopted widely for all kinds of postwar applications. ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh, Pennsylvania.

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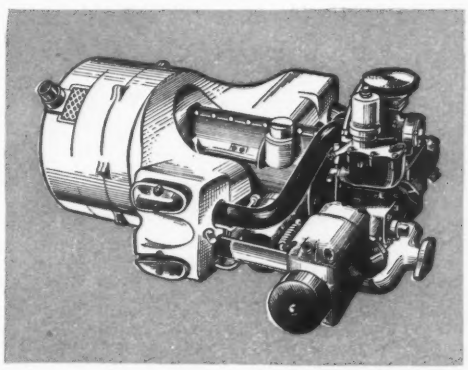

Lawrance Auxiliary Power Plant
Model 30C-3
Length 32¾"; Width 24"; Height 15".
Normal continuous power output 5KW.
Maximum overload capacity 7½ KW.

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Keep them flying
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American Engine Specifications—(Cont.)

AVIATION does not assume responsibility for the figures given

Manufacturer	Model	Cooling system	Number of cylinders	Cylinder arrangement	Propeller drive	Rating: Rated hp.	Rating: at r.p.m.	Rating: At altitude (ft.)	Rating: Octane fuel	Weights: Total dry without hub or starter	Weights: Lb. per hp.	Bore and stroke (in.)	Displacement (cu. in.)	Compression ratio	B.M.E.P.	Blower ratio	Dimensions: Diam. Mount. ring or distance between bearers (in.)	Dimensions: Ht. or O.D. (in.)	Dimensions: Length without starter (in.)	Valve mechanism	Cylinder construction	Type ignition	Make ignition	Make of carburetors	Are exhaust manifolds provided	Shipping Weight crated (lbs.)	D. of C. License number
Packard Motor Car Co.	Rolls-Royce V-1650-1	W	12	V	G	1080	2650	9500	100	1480	1.37	5.4x6	1649	6.0	196	8.15:1	.....	41¼	79¾	OHC	S	2M	C-5	Bendix	No	2500	.....
Pratt & Whitney Aircraft Division of United Aircraft Corp.[1]	R-985-SB3	A	9	Rad	D	400	2200	5000	91	668	1.67	5¾16x5¾16	985	6.0	118	10:1	.....	46.13	42 7/16	Prr	Al,S	2M	Scin	Strom	No	.....	.....
	R-1340-S3H1	A	9	Rad	D	550	2200	5000	91	864	1.57	5¾x5¾	1344	6.0	118	10:1	.....	51.81	43	Prr	Al,S	2M	Scin	Strom	No	.....	.....
	R-1340-S1H1	A	9	Rad	D	550	2200	8000	91	864	1.57	5¾x5¾	1344	6.0	118	12:1	.....	51.81	43	Prr	Al,S	2M	Scin	Strom	No	.....	.....
	R-1830-S1C3-G	A	14	Rad	3:2	1050	2550	7500	91	1438	1.37	5½x5½	1830	6.7	130	7.15:1	.....	48.19	61 5/32	Prr	Al,S	2M	Scin	Strom	No	.....	.....
	R-2800	A	18	Rad	.....	2000	All other data restricted																				
	6-440C-2	A	6	LId	D	175	2450	SL	65	378	2.16	4.125x5.5	441	6.0	130	.....	20.156	30.96	52.906	OHC	S	2M	Bendix-Scint	Strom	No	750	216
Ranger Aircraft Engines	6-440C-5	A	6	LId	D	200	2450	SL	87	378	1.89	4.125x5.5	441	7.5	153	.....	20.156	30.96	52.906	OHC	S	2M	Bendix-Scint	Strom	No	750	216
	SGV770-C1	A	12	VId	G	520	.....	SL		All other data restricted																	
	R760E	A	7	Rad	D	300	2250	SL	73	570	1.90	5x5.50	756	6.0	...	7.05:1	.....	45	42.44	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R760E2	A	7	Rad	D	350	2400	SL	91	570	1.90	5x5.50	756	6.3	...	9.17:1	.....	45	42.44	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R975E1	A	9	Rad	D	365	2100	SL	73	660	1.80	5x5.50	973	6.1	...	7.8:1	.....	45	42.44	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R975E3	A	9	Rad	D	450	2250	SL	91	675	1.50	.....	.....	.....	...	10.15:1	.....	.....	.....	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR2600 (A2A)	A	14	Rad	1.78:1	1600	2400	SL	100	1935	1.13	6.125x6.312	2603	6.85	...	7:1	.....	55	62.06	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR2600 (A2B)	A	14	RadI	1.78:1	1600	2400	SL	91	1935	1.21	6.125x6.312	2603	6.30	...	7:1	.....	55	62.06	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR2600 (A5A)	A	14	Rad	1.78:1	1600	2400	SL	100	1950	1.22	6.125x6.312	2603	6.85	...	7.14:1	.....	55	62.06	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR2600 (A5B)	A	14	Rad	1.78:1	1600	2400	SL	91	1950	1.22	6.125x6.312	2603	6.30	...	7.14:1	.....	55	62.06	Prr	Al,S	2M	.....	.....	.....	.....	.....
	585C14BA	A	14	Rad	2.28:1	1700	2500	SL	100	1965	1.15	6.125x6.312	2603	6.9	...	7.3:1	.....	54.25	63.40	Prr	Al,S	2M	.....	.....	.....	.....	.....
	586C14BA	A	14	Rad	1.78:1	1700	2500	SL	100	1980	1.16	6.125x6.312	.....	6.8	...	7.06 & 10.02	.....	54.25	63.40	Prr	Al,S	2M	.....	.....	.....	.....	.....
	702C9GC	A	9	Rad	1.5:1	1200	2500	SL	91	1310	1.09	6.125x6.875	1823	6.7	...	7:1	.....	55.12	50.04	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-G203A	A	9	Rad	1.5:1	1100	2500	SL	91	1310	1.19	6.125x6.875	1823	6.7	...	8.3:1	.....	55.12	50.04	Prr	Al,S	2M	.....	.....	.....	.....	.....
	704C9GC	A	9	Rad	1.5:1	1200	2500	SL	91	1320	1.10	6.125x6.875	1823	6.7	...	7.14:1	.....	55.12	50.04	Prr	Al,S	2M	.....	.....	.....	.....	.....
	728C9GC	A	9	Rad	1.5:1	1200	2500	SL	91	1310	1.09	6.125x6.875	1823	6.3	...	7:1	.....	55.12	50.04	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-G102A	A	9	Rad	1.46:1	1100	2350	SL	91	1275	1.16	6.125x6.875	1823	6.3	...	7:1	.....	55.10	48.12	Prr	Al,S	2M	.....	.....	.....	.....	.....
Wright Aeronautical Corp.[2]	GR1820-G103A	A	9	Rad	1.46:1	1000	2350	SL	91	1275	1.27	6.125x6.875	1823	6.3	...	8.31:1	.....	55.10	48.12	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-G105A	A	9	Rad	1.46:1	1100	2350	SL	91	1287	1.17	6.125x6.875	1823	6.3	...	7.14:1	.....	55.10	48.12	Prr	Al,S	2M	.....	.....	.....	.....	.....
	718C9GB1	A	9	Rad	1.5:1	1100	2350	SL	91	1287	1.17	6.125x6.875	1823	6.3	...	7.13:1	.....	55.10	48.12	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-62	A	9	Rad	1.46:1	1000	2200	SL	91	1198	1.20	6.125x6.875	1823	6.45	...	7:1	.....	54.25	47.75	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1103	1.10	.....	.....	.....	...	.....	.....	.....	43.25	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-G3	A	9	Rad	1.46:1	875	2200	SL	91	1198	1.37	6.125x6.875	1823	6.45	...	8.31:1	.....	54.25	47.75	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1103	1.26	.....	.....	.....	...	.....	.....	.....	43.25	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-G3B	A	9	Rad	1.46:1	900	2350	SL	91	1198	1.33	6.125x6.875	1823	6.2	...	8.31:1	.....	54.25	47.75	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1103	1.22	.....	.....	.....	...	.....	.....	.....	43.25	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-G5	A	9	Rad	1.46:1	1000	2200	SL	91	1210	1.21	6.125x6.875	1823	6.45	...	10:1	.....	54.25	47.75	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1115	1.11	.....	.....	.....	...	7.14:1	.....	.....	43.25	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R1820-F52	A	9	Rad	D	890	2200	SL	91	1000	1.12	6.125x6.875	1823	6.40	...	7:1	.....	54.25	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-F52	A	9	Rad	1.46:1	875	2200	SL	91	1095	1.25	6.125x6.875	1823	6.4	...	7:1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R1820-F53	A	9	Rad	D	785	2200	SL	91	1000	1.27	6.125x6.875	1823	6.4	...	8.31:1	.....	54.12	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-F53	A	9	Rad	1.46:1	770	2200	SL	91	1095	1.42	6.125x6.875	1823	6.4	...	8.31:1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-F55	A	9	Rad	1.46:1	875	2200	SL	91	1107	1.26	6.125x6.875	1823	6.4	...	10.1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1012	1.15	.....	.....	.....	...	7.14:1	.....	.....	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R1820-F56	A	9	Rad	D	785	2200	SL	91	1000	1.27	6.125x6.875	1823	6.4	...	8.83:1	.....	54.12	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	GR1820-F56	A	9	Rad	1.46:1	770	2200	SL	91	1095	1.42	6.125x6.875	1823	6.4	...	8.83:1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-F62	A	9	Rad	1.46:1	900	2350	SL	91	1095	1.21	6.125x6.875	1823	6.4	...	7:1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1000	1.10	.....	.....	.....	...	.....	.....	.....	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R&GR1820-F65	A	9	Rad	1.46:1	900	2350	SL	91	1107	1.23	6.125x6.875	1823	6.4	...	10:1	.....	54.12	47.81	Prr	Al,S	2M	.....	.....	.....	.....	.....
		D								1012	1.12	.....	.....	.....	...	7.14:1	.....	.....	43.38	Prr	Al,S	2M	.....	.....	.....	.....	.....
	R-3350	A	18	Rad	G	2000	All other data restricted																				

A —Air cooled
Al —Aluminum alloy
B —Battery
D —Direct
G —Geared
Hopp—Horizontal opposed
LId —Inline inverted
M —Magneto
NI —Nickel iron
Prr —Push rod-rocker
Rad —Radial
S —Steel
SL —Sea level
W —Liquid cooled

[1] *Some models built under license by Buick, Chevrolet, Ford and Jacobs.*

[2] *Some models built under license by Continental and Studebaker.*

Foreign Aircraft Engine Specifications

BRITISH

Manufacturer	Model	Cooling system	Number of cylinders	Cylinder arrangement	Propeller drive	Rating: Rated hp.	Rating: At r.p.m.	Rating: At altitude (ft.)	Rating: Octane fuel	Weights: Total dry without hub or starter	Weights: lb. per hp.	Bore and stroke (in.)	Displacement (cu. in.)	Compression ratio	B.M.E.P.	Blower ratio	Dimensions: Ht. or O.D (in.)	Dimensions: Length without starter	Guaranteed fuel consumption at 9 max. cruising hp. (lb. per hp. per hr.)	Max. oil consumption at rated speed	Valve mechanism	Cylinder construction	Type ignition	Make ignition	Make of carburetors	Make of starter
Alvis, Ltd.	Pelides	A	14	S.Rad.	G	1060	2150	S.L.	87	1475	1.43	5.75x6.5	2360	6.1	160	7.125:1	52	67	.....	....	prr	N.S.	2M	.....	Z	.....
Alvis, Ltd.	Pelides Major	A	14	S.Rad	G	1010	2300	S.L.	87	1475	....	5.75x6.5	2360	6.1	145	8.826:1	52	67	.....	....	prr	N.S.	2M	.....	Z	.....
Alvis, Ltd.	Leonides	A	9	Rad	G	450	3000	S.L.	87	708	1.70	4.80x4.41	718.5	6.3:1	152	6.5:1	41.5	52	.....	....	prr	N.S.	2M	.....	Z	.....
Armstrong Siddeley Motors, Ltd.	Cheetah XI	A	7	Rad	G	415	2650	7500	87	750	1.80	5. x5.25	759	6.35:1	163	6.25:1	43.3	52.7	.....	....	prr	Hi.	2M	.....	C.H.	.....
Armstrong Siddeley Motors, Ltd.	Panther X	A	14	Rad	G	700	2250	3000	87	1070	1.53	5.25x5.5	1667	6.35:1	147	5.88:1	47.7	59	.....	....	prr	AL.	2M	.....	C.H.	.....
Armstrong Siddeley Motors, Ltd.	Tiger IXC	A	14	Rad	G	805	2375	6500	87	1260	1.62	5.5 x6	1996.4	6.25:1	129	4.5:1	50.8	68.3	.....	....	prr	S.-AL.	2M	.....	C.H.	.....
Bristol Aeroplane Co., Ltd.	Mercury XII	A	9	Rad	G	820	2400	3500	87	1010	1.22	5.75x6.5	1520	6.25:1	178	.....	51.5	.....	.....	....	prr	AL.	2M	Rotax	C.H.	.....
Bristol Aeroplane Co., Ltd.	Pegasus XXVII	A	9	Rad	G	830	2475	11000	87	1040	1.25	5.75x7.50	1753	0.572:1	151	.....	55.3	.....	.....	....	prr	S.	2M	Rotax	C.H.	.....
Bristol Aeroplane Co., Ltd.	Hercules II	A	14	S.Rad	G	1150	2400	5000	..	1680	1.46	5.75x6.5	2360	.....	160	.....	52	.....	.....	....	.....	.....	2M	Rotax	C.H.	.....
Bristol Aeroplane Co., Ltd.	Taurus II	A	14	S.Rad	G	900	2800	5000	..	1300	1.44	5. x5.6	1550	.....	164	.....	46.25	.....	.....	....	.....	.....	2M	Rotax	C.H.	.....
Bristol Aeroplane Co., Ltd.	Perseus XIVC	A	9	Rad	G	710	2400	4000	..	1100	1.57	5.75x6.5	1520	.....	154	.....	52	.....	.....	....	.....	.....	2M	Rotax	C.H.	.....
Bristol Aeroplane Co., Ltd.	Aquila IV	A	9	Rad	G	470	2600	4500	73	830	1.76	5. x5.37	950	.....	150	.....	46	.....	.....	....	.....	.....	2M	Rotax	C.H.	.....
Cirus	Major	A	4	L.Id	D	150	2450	S.L.	..	325	2.35	4.72x5.51	386	5.8:1	128	.....	29.96	42.91	.....	1-2	prr	S.	2M	.....	C.H.	.....
De Havilland Aircraft Co., Ltd.	Gipsy Major II	A	4	L.Id	D	140	2400	S.L.	77	315	2.52	4.65x5.51	374	6:1	126	.....	32	50.35	.....	....	prr	S.	2M	.....	Z	.....
De Havilland Aircraft Co., Ltd.	Gipsy Six	A	6	L.Id	D	205	2400	S.L.	77	469	....	4.65x5.51	561	6:1	126	.....	31.7	63.5	.....	....	prr	S.	2M	.....	Z	.....
De Havilland Aircraft Co., Ltd.	Gipsy Twelve	A	12	IdV	G	425	2450	7500	..	1058	2.52	4.65x5.51	1121	6:1	123	.....	37.4	82.6	.478	.....	prr	CB.-S.	2M	.....	C.H.	.....
D. Napier & Son, Ltd.	Rapier	A	16	(H)	G	395	4000	6000	..	707	1.98	3.5 x3.5	538.78	7:1	140	5.27:1	36	56.62	.427	.0315	prr	S.	2M	.....	C.H.	.....
D. Napier & Son, Ltd.	Napier-Halford Dagger	A	24	(H)	G	955	4200	S.L.	87	1390	1.56	3.8 x3.75	1027	7.5:1	171	.....	47.81	73.87	.....	....	prr	S.	2M	.....	C.H.	Rotax
D. Napier & Son, Ltd.	Napier Sabre	W	24	(H)	G	.....	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pobjoy Airmotors & Aircraft, Ltd.	Niagara	A	7	Rad	G	142	4600	S.L.	87	175	1.4	3.19x3.43	192	8.1	128	.....	26.5	.....	.....	....	prr	S.-AL.	2M	Rotax	C.H.	.....
Rolls-Royce, Ltd.	Merlin IV	W	12	V	G	990	2600	12250	87	1335	1.35	5.4 x6	1647	.....	183	.....	41.17	75.0	.....	....	prr	AL.CB.S.	2M	.....	R.-R.	.....
Rolls-Royce, Ltd.	Peregrine	W	12	V	G	860	2850	13500	87	1106	1.28	5. x5.5	1297	.....	184	.....	.....	.....	.....	....	prr	AL.CB.S.	2M	.....	R.-R.	.....
Rolls-Royce, Ltd.	Kestrel XVI	W	12	V	G	690	2500	3000	87	955	1.59	5. x5.50	1297	6:1	162	.....	40.27	69.8	.....	....	prr	.....	2M	.....	R.-R.	.....
Rolls-Royce, Ltd.	Merlin XX	W	12	V	G	1240	2850	10000	..	1450	1.17	5.4 x6	1650	6.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rolls-Royce, Ltd.	Merlin LXI	W	12	V	G	.....	.....	.....	..	1640	....	5.4 x6	1647	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rolls-Royce, Ltd.	Vulture	W	24	X	G	1845	3000	5000	..	.....	....	5 x5.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

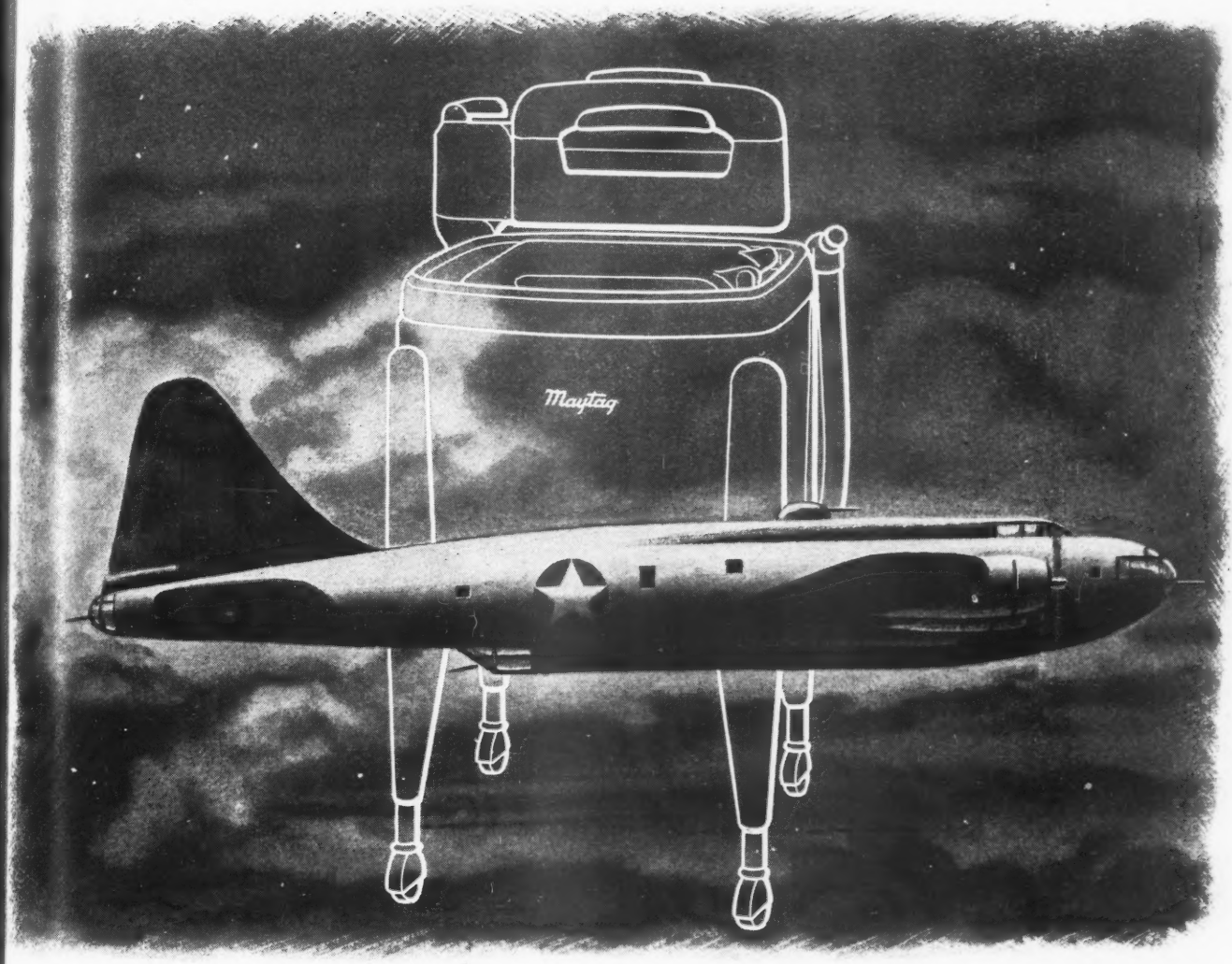
GERMAN

Argus Motoren G.m.b.H.	Argus As. 410	A	12	V.Id	G	450	3100	S.L.	..	694.5	2.06	4.1 x4.5	732.3	6.4:1	123	.....	38.18	62.4	42.44	.....	prr	S.-AL.	M	.....	.....	.....
Bayerische Motoren Werke A.G.	B.M.W. 132	A	9	Rad	D	830	2150	3280	..	1015	1.24	6.12x6.37	1690	6.5:1	180	.....	54.33	49.29	.507	4.4:88	prr	S.-AL.	M	Bosch	Pallas	Bosch
Bayerische Motoren Werke A.G.	B.M.W.-801A	A	14	Rad	G	1460	2400	16250	..	2430	....	6.15x6.15	2520	6.5:1	....	5.07x1	52.	58.	.....	....	prr	S.	2M	Bosch	.....	Bosch
Bayerische Motoren Werke A.G.	B.M.W. 802	A	14	Rad	G	2000*	.....	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brandenburgische Motorenwerke	Bramo Fafnir 323	A	9	Rad	G	920	2500	S.L.	..	1199	1.44	6. x6.3	1636	6.4:1	173	.....	54.6	55.8	.....	.....	prr	.....	M	.....	.....	.....
Diamler-Benz Aktiengesellschaft	Mercedes-Benz D-B 600	W	12	V.Id	G	800	2200	S.L.	87	1200	1.5	5.91x6.3	2069	6.5:1	139	.....	39.37	67.7	.495	.0111	ohc	S.	M	Bosch	.....	.....
Diamler-Benz Aktiengesellschaft	Mercedes-Benz D-B 602 Die	W	16	V	G	1200	1600	S.L.	..	4400	4.88	6.89x9.05	5401	16:1	48	.....	53.19	106	.37	.0066	prr	S.	.....	.....	.....	.....
Diamler-Benz Aktiengesellschaft	Mercedes-Benz D-B 601	W	12	V.Id	G	1050	2500	S.L.	..	1268	1.27	5.91x6.3	2069	6.9:1	153	.....	40.5	67.5	.....	.....	ohc	.....	.....	Bosch	.....	.....
Hirth Motoren G.m.b.H.	H.M. 506-A	A	6	L.Id	D	160	2500	S.L.	..	328	2.31	4.1 x4.52	364.7	6:1	119	.....	28.66	49.8	.495	.....	prr	C.	M	Bosch	Pallas Zenith	.....
Hirth Motoren G.m.b.H.	H.M. 508D-1	A	8	V.Id	G	280	3000	S.L.	..	485	2.	4.1 x4.52	486.4	6:1	127	.....	32.05	51.5	.571	.....	prr	C.	M	Bosch	Pallas Zenith	.....
Hirth Motoren G.m.b.H.	H.M. 512-A	A	12	V.Id	G	400	3100	S.L.	..	593	1.98	4.1 x4.52	728	6:1	116	4.4:1	32	61	.473	.005	prr	C.	M	Bosch	Pallas Zenith	.....
Junkers Motorenwerke A.G.	Die. Jumo 205-C	W	6	Vl-Opp	GI	510	2100	S.L.	..	1147	2.25	4.13x2.x6.3	1014	17:1	94	.....	52.16	76.5	.385	.002	.....	S.	.....	.....	.....	.....
Junkers Motorenwerke A.G.	Jumo 210-B	W	12	V.Id	G	540	2600	S.L.	87	958	1.70	4.88x5.3	1202	6.5:1	136	.....	70.87	58.19	.....	.....	prr	S.-AL.	M	.....	.....	.....
Junkers Motorenwerke A.G.	Jumo 210-G	W	12	V.Id	G	700	2700	S.L.	..	983	1.40	4.88x5.3	.....	6.5:1	170	.....	37.91	58.19	.504	.....	prr	S.-AL.	M	.....	.....	.....
Junkers Motorenwerke A.G.	Jumo 211-C	W	12	V.Id	G	1000	2300	S.L.	..	1278	1.59	5.91x6.5	2136	6.5:1	....	.....	40.67	66.46	.....	.....	prr	S.-AL	M	.....	.....	.....
Junkers Motorenwerke A.G.	Jumo 211-Ba	W	12	V.Id	G	1100	2400	S.L.	..	1356	1.24	5.91x6.5	.....	6.5:1	....	.....	41.69	68.7	.470	.....	.....	S.-AL.	M	.....	.....	.....

ITALIAN

Alfa-Romeo	126 R.C. 34	A	9	Rad	G	750	2300	11150	87	1068	1.42	5.75x7.48	1747	6.5:1	153	10:1	55.4	52.3	.45	....	prr	N.-S.	2M	Marelli	Mona Hobson	.....
Alfa-Romeo	126 R.C. 10	A	9	Rad	G	800	2300	3280	87	1068	1.42	5.75x7.48	1747	6.5:1	157	7:1	55.4	52.3	.....	....	prr	N.-S.	2M	Marelli	Mona Hobson	.....
Alfa-Romeo	127 R.C. 55	A	9	Rad	G	650	2400	18000	87	1054	1.62	5.75x7.48	1747	7.12:1	122	7.12:1	55.4	52.3	.....	....	prr	N.-S.	2M	Marelli	Mona Hobson	.....
Alfa-Romeo	128 R.C. 21	A	9	Rad	G	860	2300	6900	87	1135	1.32	5.75x7.48	1747	8.8:1	144	7:1	55.4	52.3	.....	....	prr	N.-S.	2M	Marelli	Mona Hobson	.....
Alfa-Romeo	130 R.C. 32	A	9	Rad	G	700	2400	10500	87	1012	1.44	5.75x6.5	1516	6.5:1	152	8.8:1	.....	.....	.....	....	prr	N.-S.	2M	.....	.....	.....
Alfa-Romeo	135 R.C. 34	A	18	S.Rad	G	1400	2400	10500	87	2100	1.5	5.75x6.3	2940	6.6:1	157	9.26:1	51.8	70	.....	....	prr	N.-S.	2M	.....	Zenith	.....
Alfa-Romeo	110-1	A	4	L.Id	D	120	2100	S.L.	87	322	2.68	4.65x5.51	373.5	5.55:1	121	.....	.....	.....	.53	....	prr	S.	2M	.....	Mona Hobson	Ec.
Alfa-Romeo	115-1	A	6	L.Id	D	185	2100	S.L.	..	476	2.57	4.65x5.51	560	5.55:1	125	.....	.....	.....	.52	....	.....	.....	.....	.....	Mona Hobson	Ec.
Compagnia Nazionale Aeronautica	C.N.A. C.V.I. I.R.C. 43	A	6	L.Id	G	160	3600	S.L.	..	408	2.7	3.54x4.33	256	.....	136.5	.....	.....	.....	.54	....	.....	S.-AL.	.....	.....	.....	.....
Compagnia Nazionale Aeronautica	C.N.A. C. 7	A	9	Rad	G	180	4800	S.L.	..	275	1.53	3.14x3.33	235	7.1:1	126	1	.....	.....	.....	....	.....	S.-AL.	2M	Marelli	Memini	.....
Societa Anonima F.I.A.T.	A-74-R.C. 38	A	14	S.Rad	G	840	2400	12450	87	1257	1.49	5.51x5.70	1907	7:1	145	8.7:1	47.07	59.45	.595	....	.....	S.-AL.	2M	Marelli	.....	.....
Societa Anonima F.I.A.T.	A-74-R.C.I. 42	A	14	S.Rad	G	770	2300	13760	87	1257	1.49	5.51x5.70	1907	7:1	145	8.7:1	47.07	59.45	.595	....	.....	S.-AL.	2M	Marelli	.....	.....
Societa Anonima F.I.A.T.	A-80-R.C. 41	A	18	S.Rad	G	1000	2100	13445	87	1600	1.6	5.51x6.50	2788	6.7:1	135	9.37:1	52.56	59.37	.595	....	.....	AL.-S.	2M	Marelli	.....	.....
Societa Anonima F.I.A.T.	A-82-R.C. 42	A	18	S.Rad	G	1250	2300	13800	..	1916	1.53	5.51x6.50	2788	6.7:1	135	9.37:1	52.56	59.37	.....	....	.....	AL.-S.	2M	Marelli	.....	.....
Isotta-Fraschini	Asso L-121-R.C. 40	W	12	V	G	900	2350	13120	..	1310	1.45	5.75x6.3	1992	6.4:1	154	10.7:1	43.54	83.78	.529	....	.....	S.	2M	.....	I.F.	.....
Isotta-Fraschini	Asso L-1801-R.C. 15/40	W	18	Id-W	G	1350	2350	13120	87	.....	.....	5.75x6.3	2945	6.4:1	154	.....	49.06	100	.525	....	.....	S.	.....	.....	.....	.....
Isotta-Fraschini	Delta R.C. 35 I.S.	W	12	VId	G	700	2400	11480	87	1122	1.60	5.2 x6.3	1605	6.4:1	134	5.95:1	34.79	78.8	.594	.022	.....	S.-AL.	2M	.....	I.F.	.....
Isotta-Fraschini	Gamma R.C. 151	W	12	VId	G	515	2500	11480	87	858	1.66	4.9x5.11	1171	6.5:1	139	.....	.....	.....	.572	.013	.....	S.-AL.	2M	.....	I.F.	.....
Piaggio & C. Societa Anonima	P.X.R.	A	9	Rad	G	670	2350	S.L.	..	959	1.43	5.75x6.49	1515	6:1	149	7.35:1	.....	.....	.....	.....	ohc	CR. NC. S.	2M	Marelli	Piaggio	.....
Piaggio & C. Societa Anonima	P.X. R.C. 35	A	9	Rad	G	625	2250	11482	..	948	1.51	5.75x6.49	1515	6:1	....	7.35:1	.....	.....	.474	.016	ohc	CR. NC. S.	2M	Marelli	Piaggio	.....
Piaggio & C. Societa Anonima	P.X. R.C. 40	A	14	S.Rad	G	1000	2200	13120	..	1444	1.44	5.75x6.49	2354	.....	153	7.84:1	.....	.....	.339	.....	ohc	CR. NC. S.	2M	Marelli	Piaggio	.....
Piaggio & C. Societa Anonima	P. XII R.C.-35	A	18	S.Rad	G	1600	.....	.....	..	1870	1.55	5.75x6.93	3236	6.5:1	143.5	.....	55.5	66.9	.484	.022	ohc	CR. NC. S.	2M	Marelli	Piaggio	.....
Piaggio & C. Societa Anonima	P. XVI R.C.-35	A	9	Rad	G	578	2150	S.L.	87	1474	2.26	5.75x6.49	1515	6.5:1	158	.....	50.23	57.16	.484	.0176	ohc	CR. NC. S.	2M	Marelli	Piaggio	.....

A—Aircooled. CB—Carbon steel. CR. NC.—Chrome nickel. Ec.—Eclipse. GI—Cylinders in H. M.—Magneto. Opp.—Opposed. Rad.—Radial. V—Vee.



From Washing Machines to Precision Aircraft Parts

Again proving it's Maytag "Know How" that counts

FOR nearly half a century Maytag has been a household word. To millions it stands for world leadership in domestic washing machines. When America called for war production, long before Pearl Harbor, Maytag enlisted and asked for tough and exacting assignments. One such assignment was the manufacture of hydraulic cylinders for combat aircraft. The rest of the story is quite typical of American productive genius. By dint of hard work, long hours, and engineering skill, Maytag has redesigned, simplified, and speeded up the building of these devices. For twenty years Maytag has held world leadership among washing machine manufacturers. It is typical of Maytag "know how" and perhaps symbolic of their washers of the future, that in a few short months Maytag has been able to attain an outstanding position in the field of hydraulics.

THE MAYTAG COMPANY, NEWTON, IOWA

1893—For Half a Century—1943

- **ELECTRIC ACTUATING DEVICES FOR AIRCRAFT**
- **HYDRAULIC ACTUATING CYLINDERS FOR AIRCRAFT**
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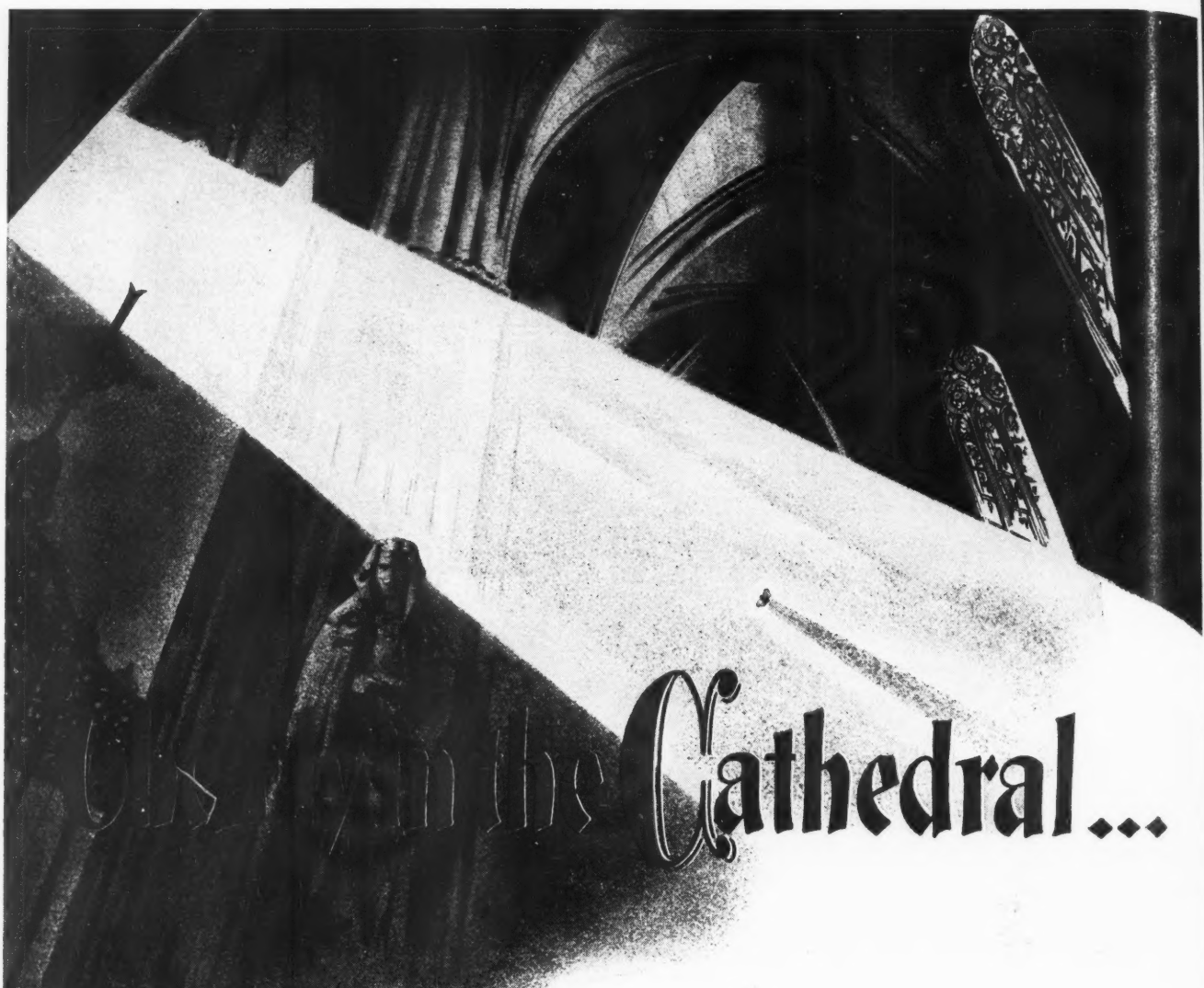
The famous Maytag Aluminum Foundry, producer of millions of cast aluminum washer tubs, is now an important source of high-grade, heat-treated aluminum aircraft castings.

Maytag

PRECISION AIRCRAFT PARTS



Cathedral...

Two million atoms could lie in a line across the dot of an i — yet each alone is a complete solar system, with electrons whirling around a central nucleus like planets around the sun. And that nucleus occupies no more space in its lonely atomic universe than a fly in a cathedral.

This is the physicist's picture of the atom, source of all energy. And today, with giant cyclotrons, he is smashing the atom — hurling these tiny planetary systems at each other with the speed of shooting stars, and with miraculous results: Sodium transformed into magnesium, aluminum into phosphorus — and the atom itself into power beyond the wildest dreams of Watt or Diesel or Edison. . . . In an ordinary glass of water is the potential power of a billion kilowatt hours!

When will industry be able to harness atomic power? Possibly in six months, six years, or not for six decades, but of this you can be certain: One day, just as sure as the earth revolves about the sun, every form of power machinery in use today will be totally obsolete.

This story of atomic power is only an extreme illustration of the problems that industry faces as a result of *change*.

Today, we are living in the midst of far greater and swifter change than the average business is prepared for. As a result, many businesses — seemingly on the rise — are actually on the brink of failure in the new world of post-war production.

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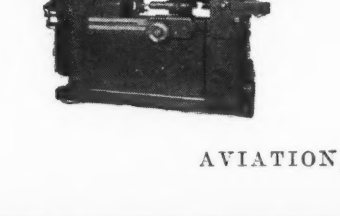

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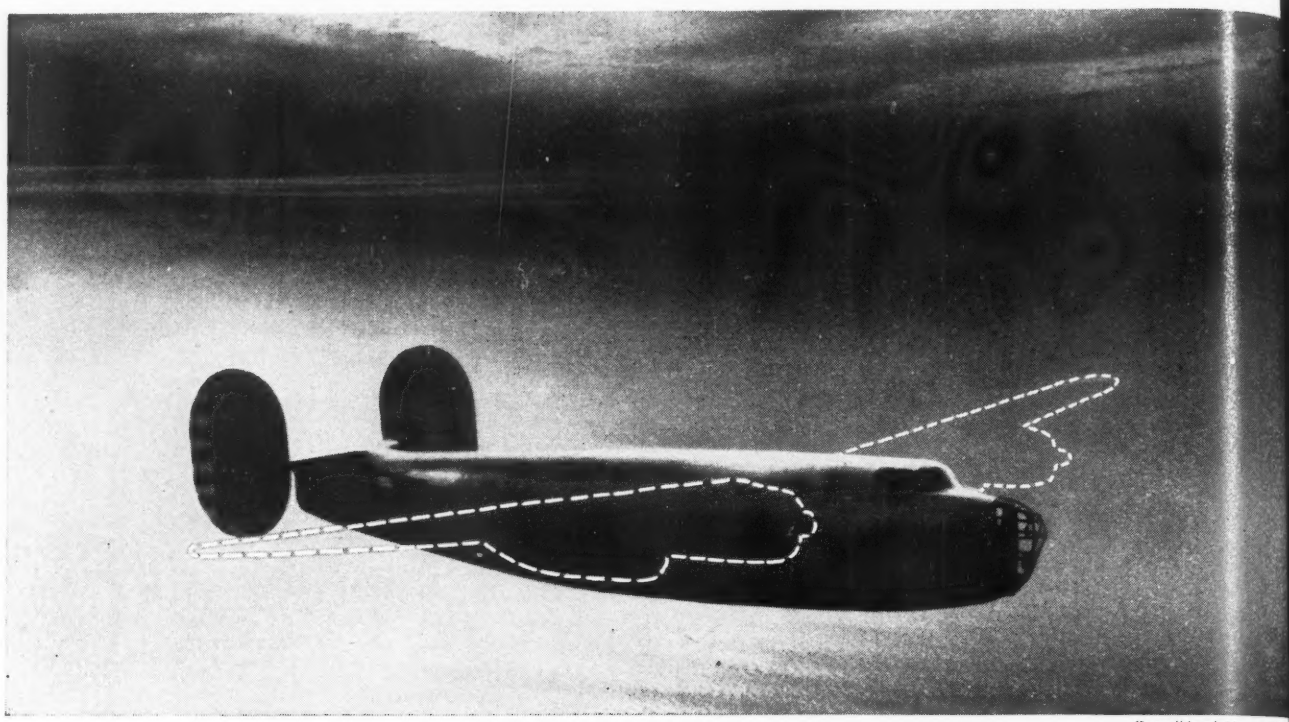

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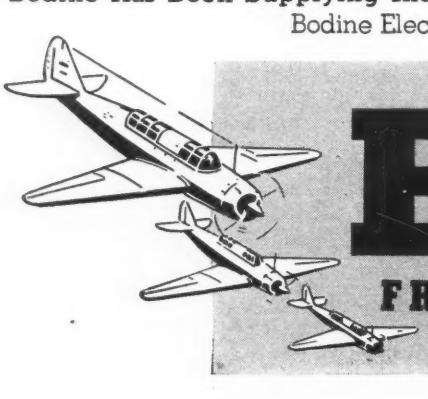

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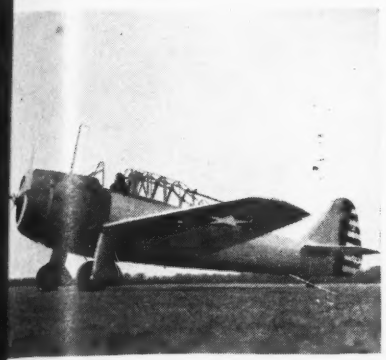

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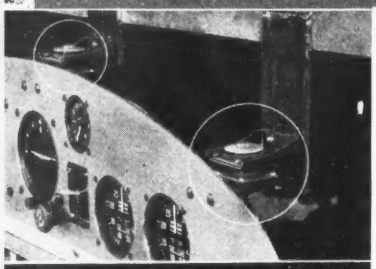

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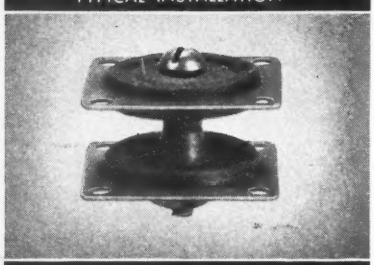

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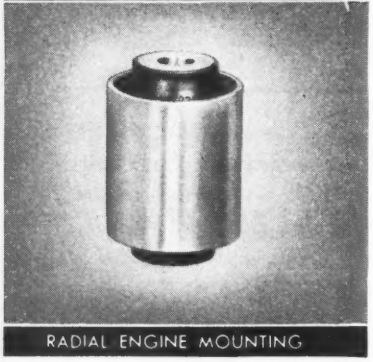

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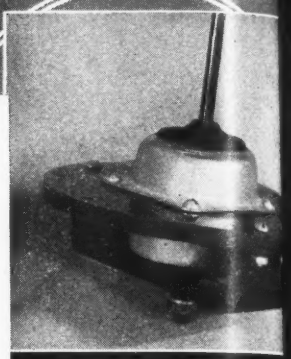

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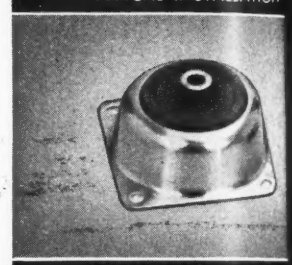

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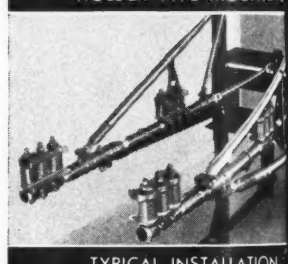

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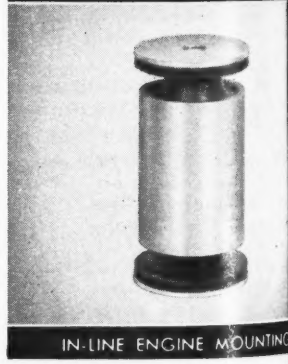

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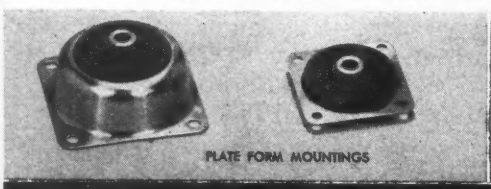

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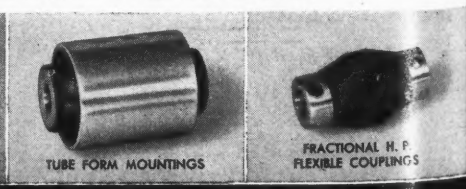

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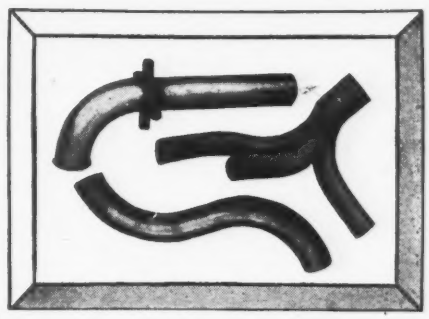

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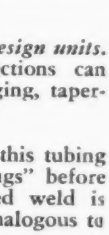

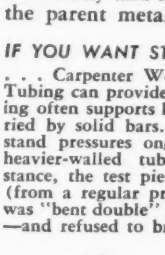

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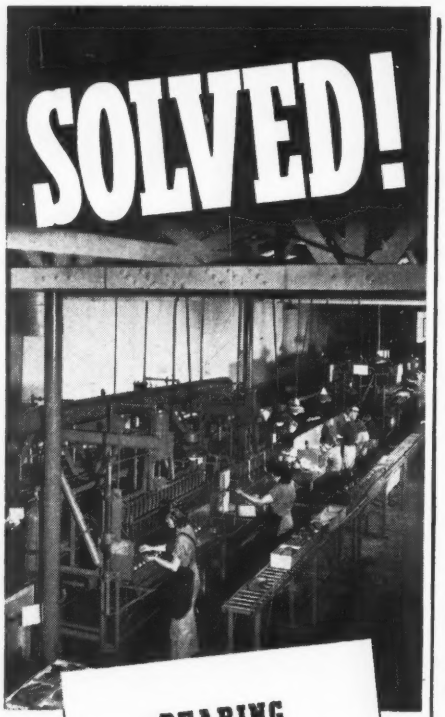

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Aero Industries Technical Institute, 5245 W. San Fernando Rd., Los Angeles, Cal., Pres. & Gen. Mgr.—Ralph Hemphill

Aeronautical Institute of Technology, Pico Blvd., Los Angeles, Cal., Pres.—Leland T. Abbott; Registrar—C. F. Griswold

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Aviation Preparatory School, 240 S. Market, Wichita, Kans., Owners—P. J. Sharp, Cecil McCullough; Registrar—Katryn Baker

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B

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C

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Isaac Delgado Central Trade School, 615 City P... Ave., New Orleans, La., Dir.—H. G. Martin

Detroit Institute of Technology, 2020 Witherell St., D... troit, Mich.

Dodge Telegraph & Radio Institute, 405-407 Mee... St., Valparaiso, Ind., Pres.—J. B. Hershman; Re... trar—E. W. Davis

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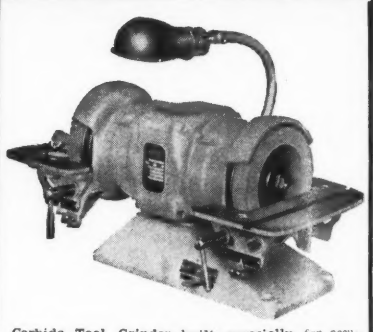

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Lewis School of Aeronautics, Lockport, Ill., Supt.—John H. Wilson; Registrar—Robert F. Blaine

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M

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Missouri Aviation Institute, 334 Richards Rd., Municipal Airport, Kansas City, Mo., Pres.—Homer L. Bredouw; Registrar—A. W. Villmoare

Missouri Institute of Aeronautics, Inc., Harvey Parks Airport, Sikeston, Mo., Pres.—Oliver L. Parks; VP & Registrar—Alden B. Woodbury

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National Aeronautics Council, Inc., 37 W. 47th St., New York, N. Y., Pres.—J. J. Crawley; Registrar—M. J. Maher

National School of Aeronautics, 26th & McGee Sts., Kansas City, Mo., Pres.—A. A. Price; Registrar—John Vale

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O

Oregon Institute of Technology, 831 S.W. 6th Ave., Portland, Ore., Pres.—Dr. Edward L. Clark; Registrar—J. B. Dinsdale

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Pacific Aeronautical College, Inc., Los Angeles Municipal Airport, Inglewood, Cal., Pres. & Registrar—C. L. Johns

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Sansom Technical Trade School, Inc., 157 Charter Oak Ave., Hartford, Conn., Pres.—Frederick P. Sansom; Registrar—Irving Sansom

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Stewart Technical School, 253 W. 64th St., New York, N. Y., Pres.—William H. Stewart; Registrar—Anthony R. Shaw

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WITH LIST OF SUPPLIERS

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THIS DIRECTORY of aviation suppliers is in two parts: The first, beginning on this page, is a listing of companies alphabetical order under specific headings of products made services supplied. The second, beginning on page 311 is a raight alphabetical listing of companies without reference to oducts or services and including addresses and personnel.

Because of the vast numbers of aviation products, it is not feasible to make a separate classification for each one. If the product sought is not found in a separate classification the reader is asked to refer to the classification most likely to include such a product.

Space limitations make it impossible to give a complete list of key personnel, but we believe a sufficient list is included to serve most purposes of correspondence or negotiation.

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RFRAME PARTS & UBASSEMBLIES
& F Aluminum Prods. Co.
e Mfg. Corp.
dams & Westlake Co., The
erco Corp.
eronautical Mfg. Corp.
r Transport Equip. Co.
r Transport Mfg. Co.
craft Associates, Inc.
craft Components, Inc.
craft Products, Inc.
craft Specialties Co.
craft Welders, Inc.
lied Aviation Corp.
uminum Co. of America
erican Aviation Corp.
erican Central Mfg. Corp.
ex Tool Co., Inc., The
mstrong Cork Co.
rnolt Motor Co.
iation Engineering, Inc.
beock Aircraft Corp.
llanca Aircraft Corp.
endix Aviation Prods.
nson Mfg. Co.
rger Mfg. Div.
rkey & Gay Furniture Co.
rner Roller Bearing Co.
rasco Mfg. Co.
ngas Mfg. Co.
ill Co., The J. G.
istol Aeronautical Corp.
rpenter Mfg. Co., E. W.
arles Mfg. Co.
le Steel Equipment Co., Inc.
cate Aircraft Corp.
lumbia Aircraft Corp.
lumbia Aircraft Ind.
lumbia Aircraft Prods., Inc.
ntinental Can Co.
sco Mfg. Co.
rry-Jamestown Mfg. Corp.
nningham Hall Aircraft Corp.
rtiss-Wright Airplane Div. (Columbus, O.)
de Aircraft Div.
yton Mfg. Co., The
yton Wheel Co.
lan Aircraft Mfg. Co.
o Aircraft Corp.
pel Aircraft Specialties
hineering & Research Corp.
rbot Products Co.
hlin Mfg. Co.
restone Aircraft Co.
eetwings, Inc.
tcher Aviation Corp.
ur City Ornamental Iron Co.
ankfort Sailplane Co.
& H Tool & Mfg. Co.
General Aircraft Corp.
General Bronze Corp.
Goodyear Aircraft Corp.
Goshen Veneer Co.
Graham-Paige Motors Corp.
Grand Rapids Industries, Inc.
Guth Co., The Edwin F.
Hammond Aircraft Co.
Hardman Aircraft Prods., Inc.
Hardman Peck & Co.
Hardware Specialties Mfg. Co
Harvey Machine Co.
Hayes Mfg. Corp.
Hill Aircraft Streamliners Co.
Hoosier Lamp & Stamping Corp.
Hudson Motor Car Co.
Intercontinent Aircraft Corp.
Kay Products Co.
Kenyon Instrument Co., Inc.
Keystone Aircraft Prods., Inc.
King Plastics Corp.
Knape & Vogt Mfg. Co.
Langley Instr. & Mach. Co.
Lavelle Aircraft Corp.
Lawrance Engrg. & Research Corp.
Lester Industries, Inc.
Liberty Aircraft Products Corp.
Lorenzen Industries
Luscombe Airplane Corp.
Lyon Metal Products, Inc.
McQuay, Inc.
Mercury Aircraft, Inc.
Miller Co., The A. J.
Morrow Aircraft Corp.
Motor Products Corp.
Motors Metal Mfg. Co.
Murray Corp. of America, The
Natl. Aircraft Equipment Co.
Natl. Aircraft Materials Corp.
Natl. Postal Meter Co.
Natl. Radiator Co., The
Neu-Bart Stamping & Mfg. Co.
Ohlsson & Rice Mfg. Co.
Oliver Farm Equip. Co.
Pacific Metals Co.
Pacific Railway Equipment Co.
Paul & Beekman Div.
Pittsburgh Plate Glass Co.
Pluswood, Inc.
Plxweve Aircraft Corp.
Posey Mfg. Co.
REF Aircraft Corp.
Reynolds Metals Co.
Robertson Aircraft Corp.
Rohm & Haas Co.
Rohr Aircraft Corp.
Ryan Aeronautical Co.
St. Louis Aircraft Corp.
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Spier Aircraft Corp.
Stainless Steel Aircraft Corp.
Steel Forming Corp.
Surface Combustion Div.
Swallow Airplane Co., Inc.
Taylorcraft Aviation Corp.
Teicher Mfg. Corp.
Tennessee Aircraft, Inc.
Torrington Co., The
Trico Prods. Corp.
Tyler Fixture Corp.
U. S. Plywood Corp.
U. S. Propellers, Inc.
Universal Bldg. Prods. Corp.
Universal Moulded Prods. Corp.
Variety Aircraft Corp., The
Voges Mfg. Co.
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Wallace Supplies Mfg. Co.
Washington Iron Works
Waukesha Motor Co.
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Western Aero. Supply Mfg. Co.
Western Mfg. & Supply Co.
Westinghouse Elec. & Mfg. Co.
Worcester Pressed Steel Co.
Zagar Tool, Inc.
Zierold Metals Co.

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Allith-Prouty, Inc.
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American Fdry. & Furnace Co.
American Gas Accumulator Co.
American Heating & Ventilating
American LaFrance-Foamite Corp.
American Paulin System
American Radiator Co.
American Radio Mfg. Co., Inc.
Appleton Elec. Co.
Athey Truss Wheel Co.
Austin Co., The
Automatic Electrical Devices Co.
Babcock Aircraft Corp.
Bardco Mfg. & Sales Co.
Briggs & Stratton Corp.
Bullard Co., E. D.
Butler Mfg. Co.
Chattillon & Sons, John
Circo Prods. Co.
Columbian Steel Tank Co.
Colvinex Corp.
Cornell Iron Wks., Inc.
Couch Co., Inc., S. H.
Couse Laboratories, Inc.
Crouse-Hinds Co.
Curtis Lighting, Inc.
Electric Air Heater Co. Div.
Evans Appliance Co.
Federal Elec. Co., Inc.
Federal Tel. & Radio Corp.
Flotation Systems, Inc.
Four Wheel Drive Auto Co.
General Die & Stamping Co.
Granberg Equip., Inc.
Edwin F. Guth Co., The
Harman Equip. Co.
Ideal Power Lawn Mower Co.
International Derrick & Equip.
Kidde & Co., Walter
Kinnear Mfg. Co.
Kron Co., The
Klauer Mfg. Co.
Logan Co.
Lumidor Mfg. Co.
Mercury Aircraft, Inc.
Lights, Inc.
Lyon Metal Prods., Inc.
Lyon-Raymond Corp.
Northill Co., Inc.
Pioneer Engrg. Wks., Inc.
Rapids-Standard Co., Inc., The
Roseman Tractor Mower Co.
Rotary Lift Co.
Scott Aviation Corp.
Streeter-Amet Co.
SoundScriber Corp., The
Sparks-Withington Co., The
Stewart, M. C.
Surface Combustion Div.
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Universal Bldg. Prods. Corp.
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Westinghouse Elec. & Mfg. Pa.
Wolfe & Mann Mfg. Co.
Worthington Mower Co.
Worthington Pump & Machy.
Yates-American Mach. Co.
Young Radiator Co.

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Hobart Brothers Co.
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Westinghouse Elec. & Mfg. Co.

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Applegate Amphibians, Inc.
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Burgess Battery Co.
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Electric Storage Battery Co.
Firestone Aircraft Co.
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Gould Storage Battery Corp.
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Ideal Commutator Dresser Co.
Prest-O-Lite Battery Co., Inc.
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Ahlberg Bearing Co.
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Lumen Bearing Co.
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McQuay-Norris Mfg. Co.
Marlin Rockwell Corp.
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Pacific Bearings Co.
Phillips Bronze Corp.
Phosphor Bronze Smelting Co.
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Randall Graphite Products Corp.
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SKF Industries, Inc.
Schatz Mfg. Co., The
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Potter, L., Inc.
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Soss Mfg. Co.
Spriesch Tool & Mfg. Co.
Townsend Co.
Voges Mfg. Co.
Weber Showcase & Fixture Co.
Werner Co., Inc., R. D.
Western Mfg. & Supply Co.

CABIN SUPERCHARGING EQUIPMENT
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Eclipse Aviation-Pioneer Instr.
General Electric Co.
Lorenzen Industries
Kenyon Instrument Co., Inc.
McCulloch Engrg. Co.
Voges Mfg. Co.

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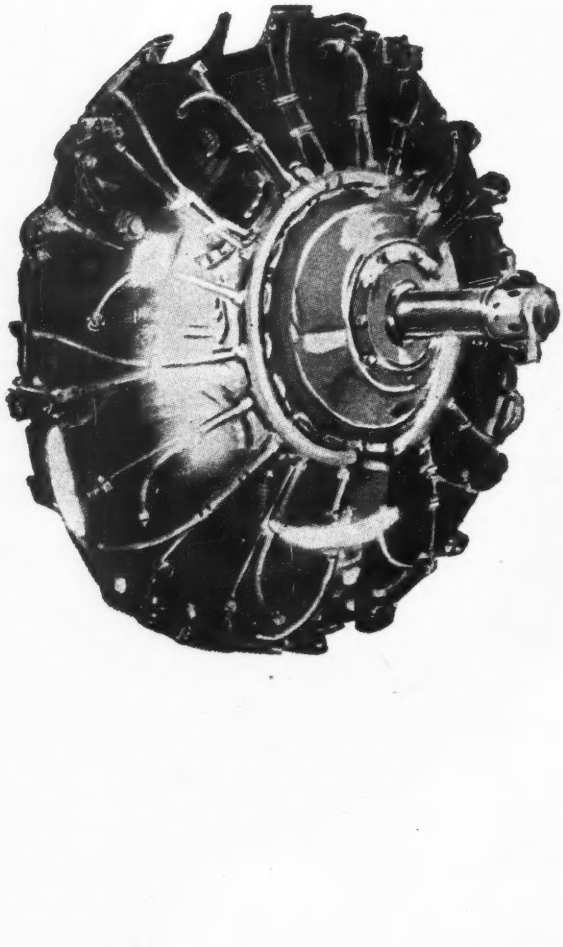
Agfa Ansco Div.
American Cellulose Co.
Aymond Co., Edw. F.
Bausch & Lomb Optical Co.



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Aviation Corp.
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aft Mechanics, Inc.
te Die Casting & Mfg. Div.
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s Fdry. & Machine Wks.
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inum Casting & Engrg. Co.
inum Industries, Inc.
ican Brass Co., The
ican Manganese Bronze Co.
ican Manganese Corp.
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Brass Fdry.
ium Metals Corp.
Aluminum & Brass Corp.
Brass & Copper Co., Inc.
on Metals, Inc.
er Alloy Fdry. Co.
Piston Corp., Ray
Cast Corp.
ler Die Casting Corp.
n Corp.
Chemical Co.
e-Smith Brass & Cpr. Co.
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Auto-Lite Co. (Toledo)
anks, Morse & Co., Wis.
ral-Mogul Corp.
Lamp Co., C. M.
ilton Fdry. & Mach. Co.
ille Aircraft Die Cstg.
es Stellite Co.
ard Fdry. Co.
y Co., J. H.
-Brunner Steel Prods., Inc.
er Aluminum Co.
en Pipe Co.
Iron Foundry
a Machine Co.
Bronze & Alum. Fdry Co.
on New Haven Co.
h Wales Mach. Co.
son & Rice Mfg. Co.
er Mach. Co.
olds Metals Co.
ers Pattern & Fdry. Co.
-Meehan Fdries.
ango-Penn Mold Co.
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ecor Heater Div.
ling Aluminum Prods., Inc.
art-Warner Corp.
ewant Co., B. F.
an & Co., E.
man Bronze & Aluminum Co.
ern Mfg. & Supply Co.
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inum Co. of America
rican Fdry. & Furnace Co.
o Metal, Inc.
ium Metals Corp.
nd Brook Oil-Less Bearing
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A Motor Div.
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on Mfg. Co., The
ker Co., Richard M.
ern Malleable Iron Co.
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chot Products Co.
anks, Morse & Co.
r City Orna. Iron Co.
eral Bronze Corp.
n Co., The Edwin F.
ard Fdry. Co.
a Machine Co.
ller Brass Co.
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American Optical Co.
Appel & Co., Inc., S.
Bausch & Lomb Optical Co.
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Chicago Uniform & Co.
Colvinex Corp.
Duplan Corp., The
Elgin Natl. Watch Co.
Goggle Parts Co., The
Jaeger Watch Co.
Joyce Aviation, Inc.
Lee Mercantile Co., The H. D.
Liberty Mirror Co.
Longine-Wittnauer Watch Co.,
Mercury Arcraft, Inc.
Mine Safety Appliances Co.
Ort, Karl
Perry Sportswear, Inc.
Pulmosan Safety Equip. Corp.
Reeves Bros., Inc.
Rough Wear Clothing Co.
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Scully Bros., Inc.
Sellstrom Mfg. Co.
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Byrne Doors, Inc.
Carey Mfg. Co., Philip
Celotex Corp., The
Clyde Iron Wks., Inc.
Columbian Steel Tank Co.
Continental Industrial Engineers
Edwards Iron Wks., Inc.
Edwards Mfg. Co.
Fibre Conduit Co.
Flynn & Emrich Co.
Herrick Iron Works
Ingalls Iron Works Co.
International Steel Co.
Judson-Pacific Co.
Keyston Asphalt Prods. Co.
Maryland Metal Bldg. Co., Inc.
Pacific Ry. Equip. Co.
Pittsburgh Steel Co.
Portland Cement Assoc.
Republic Steel Corp.
Richards-Wilcox Mfg. Co.
Robertson Co., H. H.
Roof Structures, Inc.
Southern Engineering Co.
Summerbell Roof Structures
Timber Engrg. Co.
Truscon Steel Co.
Universal Atlas Cement Co.
Universal Bldg. Prods. Corp.
Universal Engrg. Corp.

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Aeromotive Products Corp.
Aeronautical Mfg. Co.
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Airadio, Inc.
Aircraft & Marine Specialty
All American Aircraft Prods.
American Aviation Corp.
American Hard Rubber Co.
American Steel & Wire Co.
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Arnolt Motor Co.
Automatic Electric Co.
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Baldwin-Duckworth Div.
Barber-Colman Co.
Bendix Aviation, Ltd. Div.
Bendix Products Div.
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Decker Co., Richard M.
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Dolan Aircraft Mfg. Co.
Eastern Air Devices, Inc.
Eclipse Aviation-Pioneer Instr.
Electric Sprayit Co.
Frankfort Sailplane Co.
Fulton Sylphon Co., The
Grand Rapids Industries, Inc.
Guardian Electric Mfg. Co.
Hardware Specialties Mfg. Co.
Hart Mfg. Co., The
Harvey Machine Co.
Hayes Mfg. Co.
Hyland Machine Co.
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Librascope, Inc.
Lobdell-Emery Mfg. Co.
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Mfrs. Chemical Corp.
Mason Co., Thomas
Minneapolis-Honeywell Regulator
Moore-Eastwood Co.
Pacific Airmax Corp.
Peerless Mach. Co.
Powers Regulator Co.
Richland Auto Parts Co.
Robertshaw Thermostat Co.
St. Louis Aircraft Corp.
Se-Ling Aircraft Co.
Shakespeare Products Co.
Simmonds Aerocessories, Inc.
Sperry Products, Inc.
Stewart Mfg. Co., F. W.
Stow Mfg. Co.
Titan Valve & Mfg. Co., The
United Aircraft Products, Inc.
Walker-Turner Co., Inc.
Ward Leonard Elec. Co.
Weber Showcase & Fixture Co.
Western Mfg. & Supply Co.
Westinghouse Air Brake Co.
Young Spring & Wire Corp., L. A.

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Cardinal Corp., The
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Hayes Mfg. Co.
Heath Co.
Landers Corp., The
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McQuay, Inc.
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Radel Leather Mfg. Co.
Rohr Aircraft Corp.
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St. Louis Aircraft Corp.
Steel Forming Corp.
Weber Showcase & Fixture Co.

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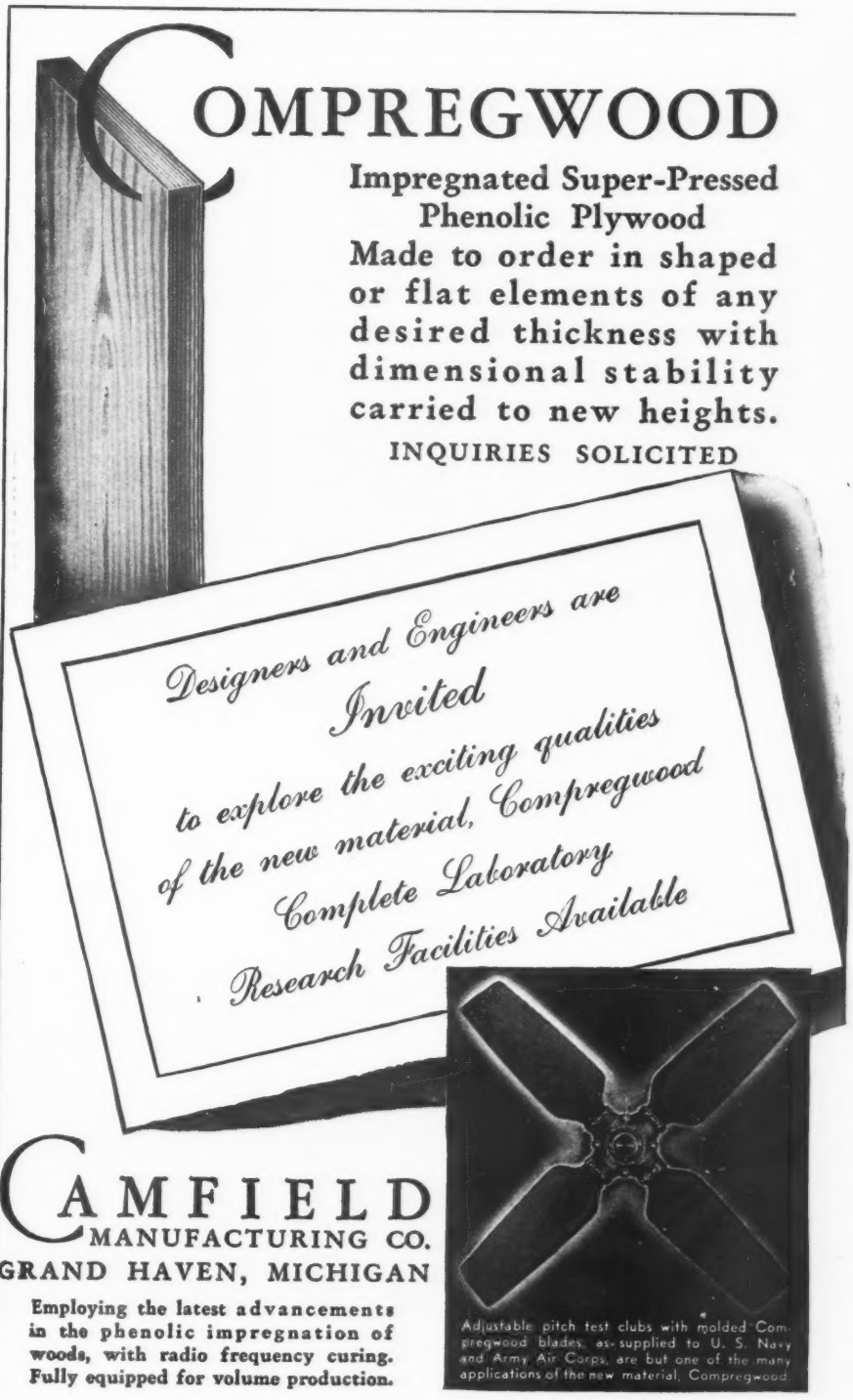
Adel Precision Products Corp.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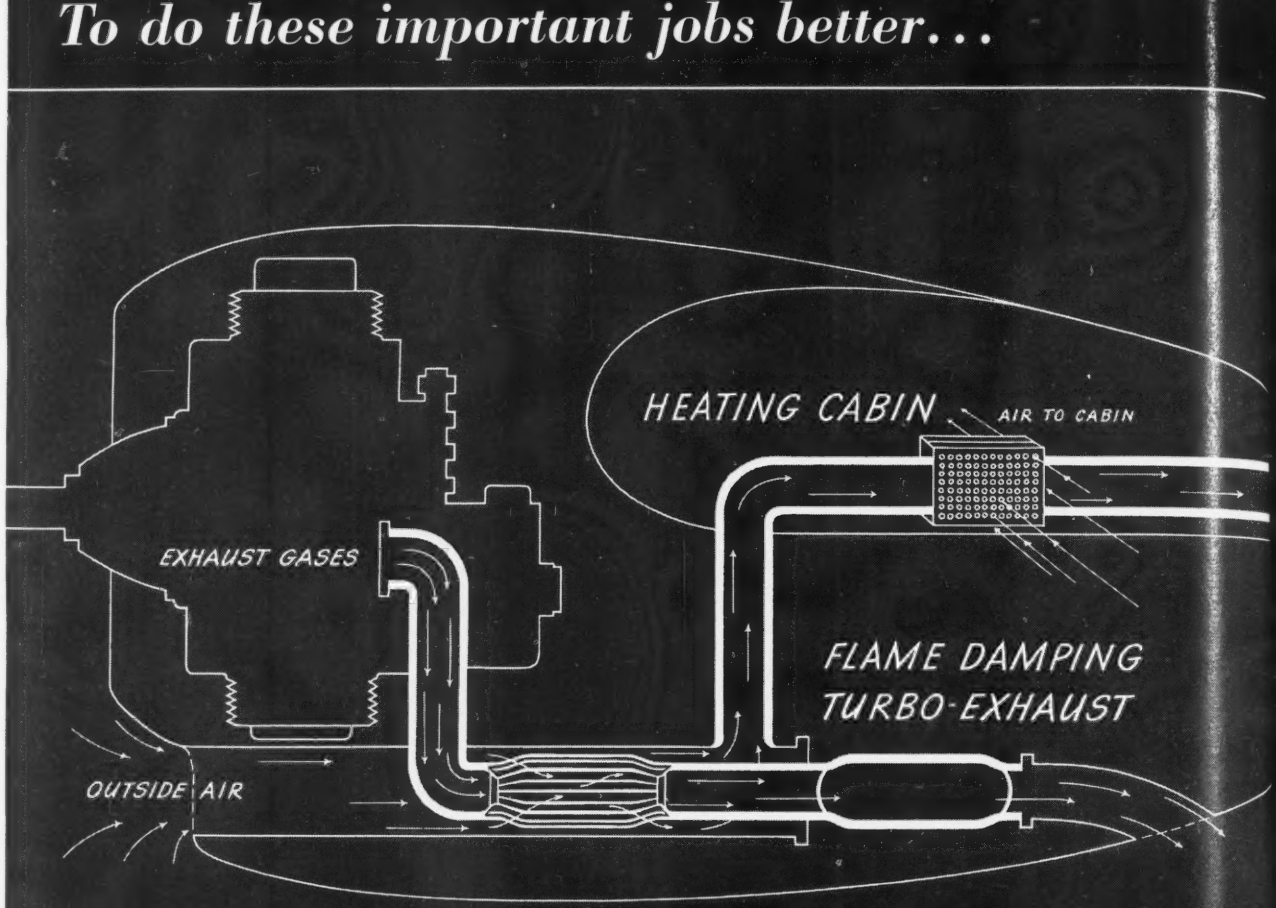

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INSTALLED AS A part of the exhaust pipe, this featherweight AiResearch unit does not weigh much more than the section of pipe it replaces.

This new AiResearch Exhaust Heat Exchanger causes little back pressure and power loss. In fact, pressure drop in the exhaust pipe remains about the same as before installation of unit.

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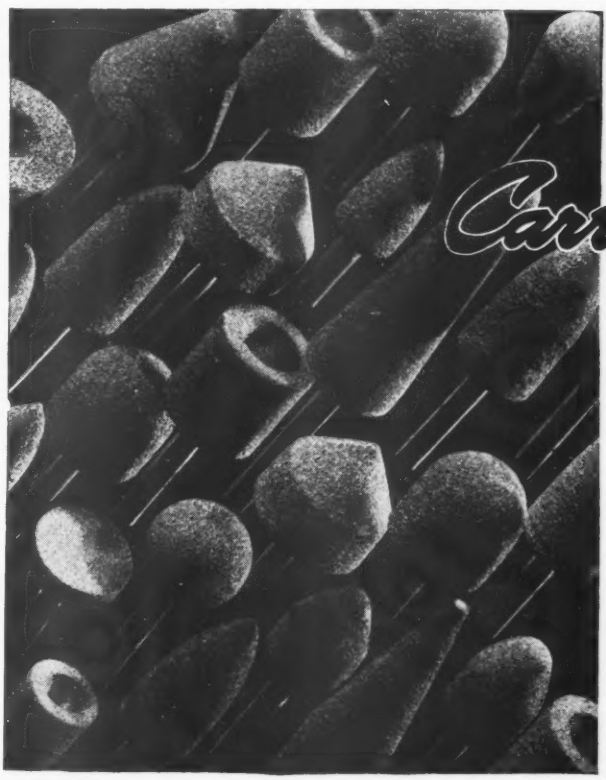

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...ohler Co.
...ulka Elec. Mfg. Co., Inc.
...ombard Governor Corp.
...unkenheimer Co., The
...uscombe Airplane Corp.
...M. B. Mfg. Co., Inc.
...acwhyte Co.
...artin-Decker Corp.
...ason Co., Thomas
...asters, Inc., Irvin W.
...olded Insulation Co.
...oore-Eastwood Co.
...ueller Brass Co.
...range Roller Bearing Co.
...ackless Metal Prods. Corp.
...arker Appliance Co., The
...hosphor Bronze Smelting Co.
...otter, Inc., L.
...oulsen & Nardon, Inc.
...restole Div.
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Shenango-Penn Mold Co.
Special Mach. Tl. Engrg. Wks.
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Steel Forming Corp.
Stewart-Warner Corp.
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Tourek Mfg. Co., J. J.
Trabon Engrg. Corp.
Tubing Seal-Cap, Inc.
Union Aircraft Prods. Corp.
Voges Mfg. Co.
Wagner Mfg. Co., E. R.
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Woodworth Co., N. A.

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Aircraft Instr. Service, Inc.
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Crouse-Hinds Co.
Duplan Corp., The
Eclipse Aviation-Pioneer Instr.
International Flare Signal Div.
McAleer Mfg. Co.
New Jersey Fulgent Co.
Owens-Corning Fibreglas Corp.
Security Parachute & Equip. Co.
Triumph Explosives, Inc.
Young Spring & Wire Corp., L. A.

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Applegate Amphibians, Inc.
B. H. Aircraft Co.
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Flour City Orna. Iron Co., The
Heath Co.
Kirkham Engrg. & Mfg. Corp.
Lester Industries, Inc.
St. Louis Aircraft Corp.
Samson United Corp.
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Washington Aircraft & Transp.
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Aircraft Steel & Supply Co., The
Airex Mfg. Co.
Altens Fdry. & Mach. Wks.
Aluminum Co. of America
American Brass Co., The
American Manganese Bronze Co.
Anti-Corrosive Metal Prods. Co.
Arnolt Motor Co.
Atlas Drop Forge Co.
Auld Co., The D. L.
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Brill Co., The J. G.
Buick Motor Div.
Canton Drop Forging & Mfg. Co.
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Dow Chem. Co.
Duff-Norton Mfg. Co., The
Endicott Forging & Mfg. Co., Inc.
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Gardner-Denver Co.
General Metals Corp.
Harrisburg Steel Co.
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Adel Precision Prods. Corp.
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Air Associates, Inc.
Aircraft Instr. Service, Inc.
Aircraft Steel & Supply Co., The
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Chandler-Evans Corp.
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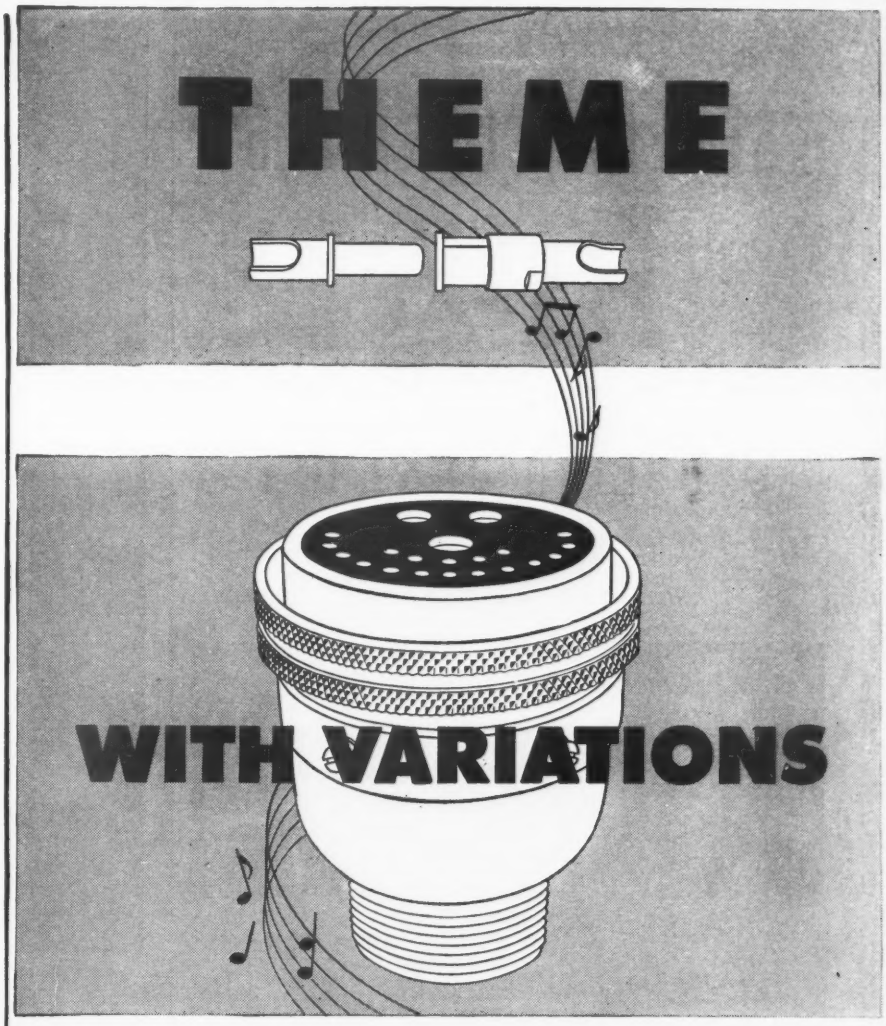
Columbia Aircraft Prods., Inc.
Connecticut Hard Rubber Co.
Curtis Pump. Co.
Delco Prods. Co.
Eastern Engrg. Co.
Eclipse Aviation-Pioneer Instr.
Grandberg Equip., Inc.



The fundamental purpose of every Cannon Connector is to connect electrical circuits quickly and securely. This theme is expressed by a single Cannon contact pin and its corresponding socket. The addition of more pins and sockets to handle more circuits is simply a variation of this fundamental theme. This means the same basic uniformity of quality and dependability in a comprehensive line of standard Cannon Connectors.

Today, *standard* Cannon Plugs are supplied in the type, style and size required for connecting every circuit used in the control and operation of modern aircraft. Cannon standardization makes for greater production speed on aircraft assembly lines . . . for faster service in the field . . . and for uniform dependability in the air.

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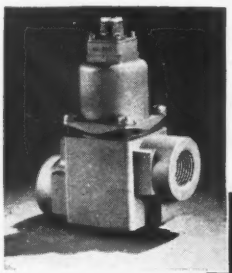
GENERAL CONTROLS

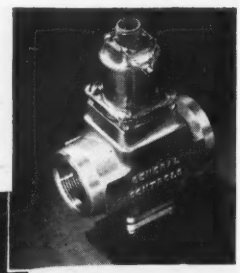
hi-g*

GASOLINE SHUT-OFF VALVES



Above: Type AV-6; ¾" and 1" full flow valve for gasoline cross feed.

Below: Type AV-5; electric diaphragm gasoline valve.



Above: Type AV-12; gasoline safety shut-off valve.

AVAILABLE UP TO 2" IN SIZE WITH HIGH FLOWS AND LOW HEAD LOSS

General Controls hi-g electromagnetic Shut-off Valves not only assure automatic and remote gasoline flow control but also simplify gear, electrical circuits, and pilot supervisory operations. They are available in a range of AN pipe sizes up to 2", with a wide range of AN electrical connectors. Because of the varied specifications, one of these three types of valves is sure to meet the requirements of most applications. Complete specifications are available upon request. Write or wire our engineering department today.

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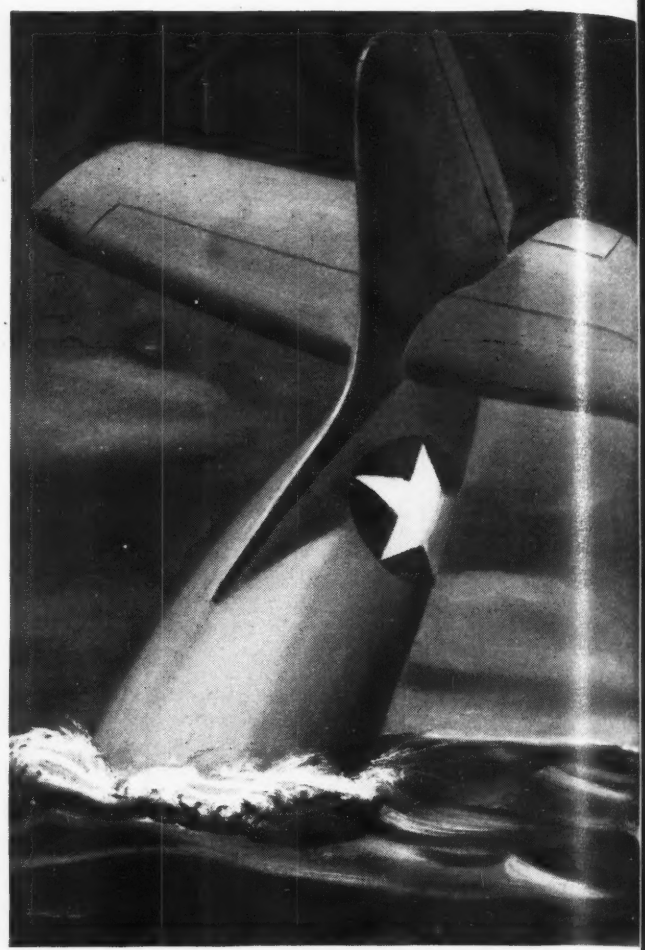

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Protectoseal Co.
Pump Engrg. Service Corp.
Romec Pump. Co.
Roper Corp., Geo. D.
Steel Prods. Engrg. Co.
Stewart-Warner Corp.
Thompson Prods., Inc.
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Western Gear Wks.

FUELS

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Ethyl Corp.
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Shell Oil Co.
Sinclair Refining Co.
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Cullman Wheel Co.
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Foote Bros. Gear & Mach. Corp.
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Meisel Press Mfg. Co.
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Avondale Chem. Co.
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Casein Co. of America
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duPont de Nemours & Co., E. I.
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American Fdry. Equip. Co.
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Reznor Mfg. Co.
Spencer Heater Div.
Stewart-Warner Corp.
Surface Combustion Div.
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Torrington Mfg. Co., The
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Utility Metal Prods. Co.
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Western Mfg. & Supply Co.
Young Radiator Co.

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Cleveland Tramrail Div.
Clyde Iron Wks., Inc.
Coffing Hoist Co.
Curtis Mfg. Co.
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Elwell-Parker Elec. Co.
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Heppenstall Co.
Hughes-Keenan Co., The
Ingersoll-Rand Co.
Judson-Pacific Co.
Louden Machy. Co.
Lyon Raymond Corp.
Malabar Mach. Co.
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Revolvator Co.
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Rotary Lift Co.
Spencer & Morris
Sprout, Waldron & Co.
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Taylor Mach. Co., The
Trowbridge Conveyor Co.
Union Mfg. Co.
Universal Bldg. Prods. Corp.
Washington Iron Wks.
West Bend Equip. Corp.
Western Gear Wks.
Whiting Corp.
Willamette Hyster Co.

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Aircraft Instr. Service, Inc.
American Brass Co., The
Breeze Corps., Inc.
Chicago Metal Hose Corp.
Eclipse Aviation-Pioneer Instr.
Everhot Products Co.
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Aeroquip Corp.
Aircraft Instr. Service, Inc.
Aircraft Steel & Supply Co., The
Bethlehem Equip. Corp., Ltd.
Bowling Green Rubber Co., The
Connecticut Hard Rubber Co.
DeVilbiss Co., The
Firestone Aircraft Co.
Flex-O-Tube Co.
Gasket Shop, The
General Tire & Rubber Co.
Goodall Rubber Co.
Goodyear Tire & Rubber Co., The
Inland Mfg. Div.
Johnson Rubber Co., The
Manhattan Rubber Div.
Philpott Rubber Co., The
Republic Rubber Div.
Resistoflex Corp.
Rodic Rubber Corp.
U. S. Flex. Metallic Tubing Co.
U. S. Rubber Co.

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Aeroquip Corp.
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Aircraft Accessories Corp. Cal.
Aircraft Engrg. Prods. Inc.
Aircraft Industries Corp.
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Aircraft Parts Production Corp.
Aircraft Specialties Co.
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Aro Equip Co., The
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Electric Sprayit Co.
Electrol Inc.
Everhot Products Co.
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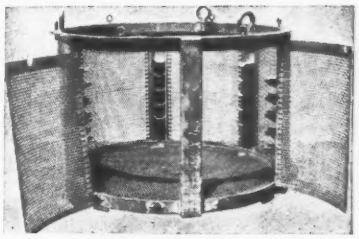
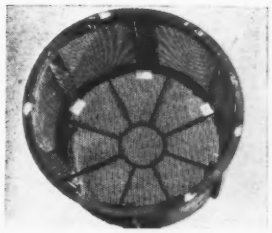
Frigidaire Div.
Fuel Development Corp.
Gardner-Denver Co.
Gladden Prods. Div.

(*Turn to page* 289)

CARBURIZING AND HEAT TREATING EQUIPMENT TO SPEED PRODUCTION

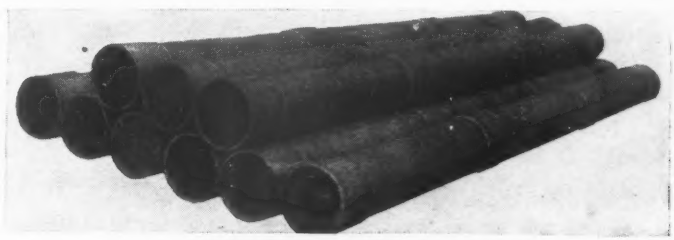


Annealing and Heat Treating Basket 6 ft. in diameter and 6 ft. high with adjustable shelves and sides.



For annealing and quenching aluminum and manganese castings. Furnished in various types to your specifications.

A group of Pickling, Dipping and Annealing Baskets that have a wide acceptance because of the high quality and carefully supervised manufacture. Furnished in any size with perforations to suit your requirements.



These Annealing Tubes are 20 ft. long and are made of lightweight alloy. Tubes like this have been in use over 10,000 hours and are still going strong.

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Power Brake Valve

Auto Pilot Selector Valve

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Hand Pump

Pilot Operated Valve

Other equipment not illustrated includes Sequence Valves, Thermal and Pressure Relief Valves, Restrictor Valves and Hydraulic Electric Switch.

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Station Box

Range Filter

Generator and Dynamotor

Tail Light Flasher

Vacuum Relay

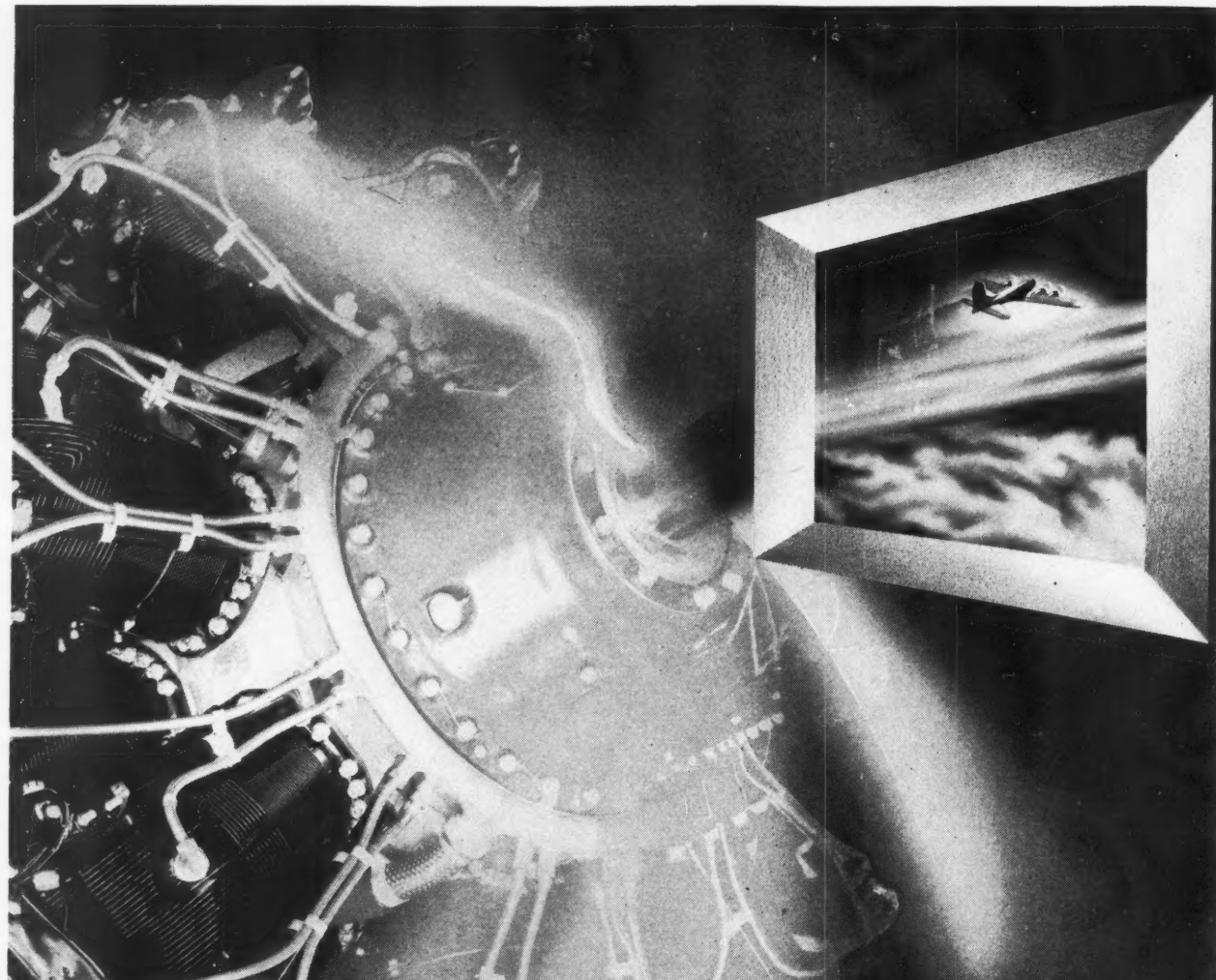
Communication System

Control Panel

Generator Filter

Other radio units not shown are Transmitters, Interference Filters, Cables

Control Unit



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HIGHER AND HIGHER into the heavens roar American fighters and bombers. The better to blast the enemy, they seek new and unscaled heights. And on "BENDIX-SCINTILLA" Aircraft Ignition depends in part their success.

For in the freezing half-twilight and thin realm of air above earth, electricity does strange things. Yet high-voltage current must be created and controlled . . . to fire accurately-timed sparks for pulsing engine power.

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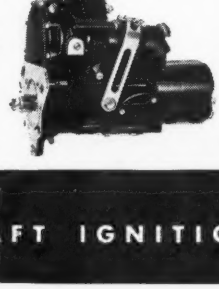
"BENDIX-SCINTILLA" Aircraft Ignition Systems are important members of "The Invisible Crew" . . . precision instruments, and controls, which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.



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...ing Seal-Cap, Inc.
...pelhoer Bros., Inc.
...kers, Inc.
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...tinghouse Air Brake Co.
...son, K. R.

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...G Corp., The
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...mon Elec. Development Corp.
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...emann Corp.
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...r & Stevens Aircraft Corp.
...mer Co., R. W.
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...dur-Amsco Corp.
...e Cast Corp.
...stern Air Devices, Inc.
...llise-Aviation-Pioneer Instr.
...lson-Splitdorf Corp.
...c. Auto-Lite Co. (Toledo)
...ctronics Labs., Inc.
...din Natl. Watch Co.
...gelhard, Inc., Chas.
...gis Equipment Co.
...rchild Aviation Corp.
...deral Telephone & Radio Corp.
...cher & Porter Co.
...rd Instrument Co.
...rboro Co.
...ez & Sons, Julien P.
...lton Syphon Co., The
...rley, W. & L. E.
...neral Elec. Co.
...rney Mach. Co.
...ys Corp.
...ath Co.
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...k & Heintz, Inc.
...dur Import Co.
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...rner Co., The
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...rascope, Inc.
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The will to do it better made E. A. Laboratories a peacetime leader for over twenty-five years. But even that effort is now surpassed by a grim determination to give our boys the best equipment that American ingenuity can conceive, that American skill can produce—*right now.* E. A. is completely converted to the manufacture of war material. Production today is up 300% over our peacetime high. And it will continue to rise. To this end, the management and employees of E. A. Laboratories pledge their all-out, fighting effort.

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Celanese Celluloid Corp.
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Commercial Plastics
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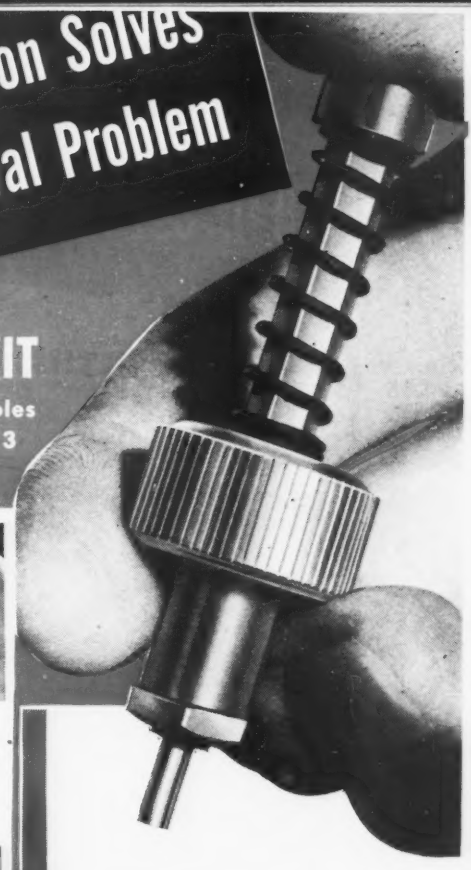
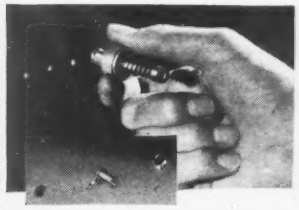
New Invention Solves Burr Removal Problem



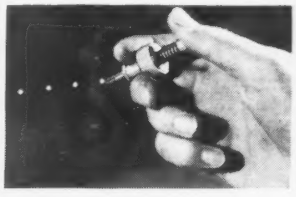
SCOVILL BURZIT

Quick-Shaves Blind Holes in Aircraft Sheets . . in 3 Simple Operations

1 Compress the spring and insert BURZIT Skin Sheet Burr Remover in rivet hole



2 After spring pressure has pulled blade back against skin sheet, turn clock-wise one full turn



3 Re-compressing the spring allows quick removal

A SCOVILL PRODUCT

SCOVILL BURZIT BURR REMOVER

QUICK SHAVES THE BURRS YOU CAN'T SEE

This quick, easy method of removing burrs from blindside holes in skin sheets saves you the time and trouble of more awkward, haphazard methods.

The Scovill BURZIT Skin Sheet Burr Remover slices off blind-side burrs positively and uniformly without danger of thinning or countersinking the skin sheet.

No particular skill is required. Merely insert in rivet hole, turn one revolution, and remove. Additional turns will do no harm, because a flat bearing section on the blade keeps it from further cutting.

The hardened tool steel cutter is accurately ground to shape, and can easily be replaced when a new cutter is ultimately required. Scovill BURZIT Skin Sheet Burr Removers are supplied for 3/32", 1/8", 5/32" and 3/16" rivet holes.

Send for sample BURZIT Skin Sheet Burr Remover **$2.25**

Attach this coupon to your business letterhead, and mail today! BURZIT Burr Removers are each fitted in a special wood container, plainly size-marked for identification and storage. This *permanent* container continues to protect them even in your operators' tool kits! Send for *your* sample — investigate quick savings with Quick-Shavings!

Scovill MANUFACTURING COMPANY WATERBURY, CONN.

SCOVILL MFG. CO.
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Send me ..... BURZIT Skin Sheet Burr Removers at $2.25.

Size of rivet hole .....

Name .....

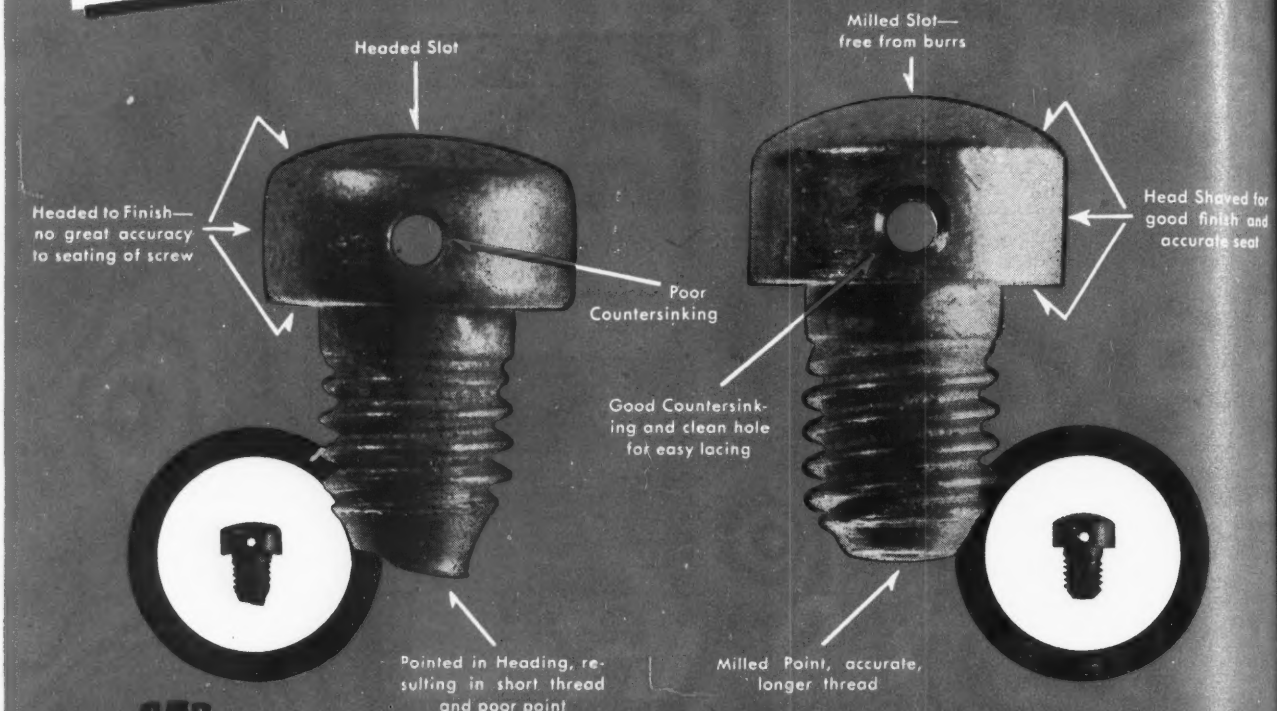
Title .....

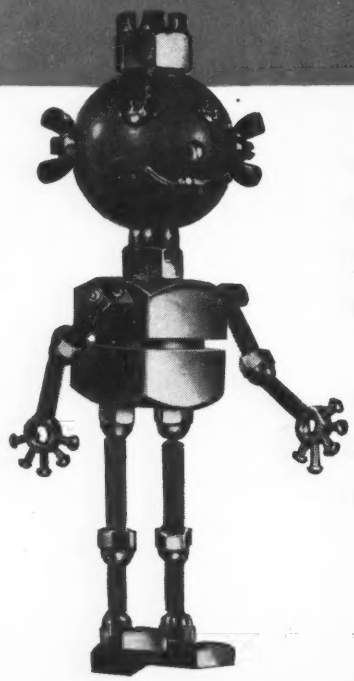
Company .....

Address .....

Screws ARE different!

AND IT'S THE MICROSCOPIC DIFFERENCES THAT COUNT IN AIRCRAFT WORK


Headed Slot
Milled Slot—free from burrs
Headed to Finish—no great accuracy to seating of screw
Head Shaved for good finish and accurate seat
Poor Countersinking
Good Countersinking and clean hole for easy lacing
Pointed in Heading, resulting in short thread and poor point
Milled Point, accurate, longer thread



It is no accident that the aircraft industry looks to National as an important source of supply for AN Aircraft Nuts. National facilities and methods of manufacture are uniquely adapted to producing both the quality and quantity that the armed services require in these indispensable fasteners.

From initial testing of the raw material to final inspection of the finished product under magnifying glass, every operation is designed to fulfill the requirements of rigid Army and Navy specifications.

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kon Co., Inc.
ler Co., Ltd.
hardson Co., The
m & Haas Co.
Ling Aircraft Co.
apent Co.
er Aircraft Corp.
dlow Aeroplastics Corp.
rthane Corp.
lor Fibre Co.
hnical Ply-Woods
er Fixture Corp.
S. Propellers, Inc.
versal Moulded Prods. Corp.
rginia-Lincoln Corp.
ertown Mfg. Co., The
rner Co., Inc., R. D.
stern Felt Wks.
stern Mfg. & Supply Co.
stinghouse Elec. & Mfg. Co.—Ohio
stinghouse Elec. & Mfg. Co.—Pa.
nborne Plastics Moulding Corp.

LATING, METALLIZING, ALVANIZING, ANODYZING, C.

me Plating Co.
merican Chem. Paint Co.
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ild Co., The D. L.
gue Elec. Co.
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lumbia Aircraft Prods., Inc.
mmonwealth Industries, Inc.
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iberson Corp., The
ith Co., The Edwin F.
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anson-Van Winkle-Munning Co.
ard Chrome Engrg. Co.
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Hommedieu & Sons Co., Chas.
etallizing Engrg. Co., Inc.
olern Plating Co.
meller Brass Co.
ecific Car & Fdry. Co.
rentol Chem. Prods., Inc.
pencer & Morris
rens, Inc., Frederic B.
ripps Mfg. Co., The
uro Prods., Inc.
dylite Corp.
niversal Bldg. Prods. Corp.
oodworth Co., N. A.

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ircraft Mechanics, Inc.
loma Plywood & Veneer Co.
ll American Aircraft Prods.
llied Aviation Corp.
merican Aviation Corp.
merican Plywood Corp.
pplegate Amphibians, Inc.
ild Co., The D. L.
ult & Wiborg Corp.
viation Engrg. Inc.
abcock Aircraft Corp.
ellanca Aircraft Corp.
erkey & Gay Furniture Co.
rill Co., The J. G.
alifornia Panel & Veneer Co.
rescent Panel Co.
ecker Co., Richard M.
rie Resistor Corp.
ahlin Mfg. Co.
restone Aircraft Co.
letcher Aviation Corp.
rankfort Sailplane Co.
isbie Veneer Co.
rand Rapids Industries, Inc.
ith Co., The Edwin F.
ammond Instr. Co.
ardman Peck & Co.
askelite Mfg. Corp.
aves Mfg. Co.
eath Co.
emnsdorf Fixture Mfg. Co.
ndiana Veneer & Panel Co.
asper Wood Prods. Co.
ester Industries, Inc.
orenzen Industries
cLaurin Jones Co.
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orrow Aircraft Corp.
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earl City Plywood Co., Inc.
ike Dial Lumber Co.
ineswood Inc.
obertson Aircraft Corp.
oddis Lumber & Veneer Co.
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tory & Clark Piano Co.
echnical Ply-Woods
. S. Plywood Corp.
. S. Propellers, Inc.
niversal Moulded Prods. Corp.
idal Research Corp.
irginia-Lincoln Corp.
eber Showcase & Fix. Co., Inc.
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iradio, Inc.
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Hamilton Standard Propellers
Hardman Peck & Co.
Hartzell Propeller Co.
Joyce Aviation, Inc.
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Bendix Radio Div.
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(*Turn to page 299*)

"Isabel" CHANGES HER MAKE-UP

Tanks, trucks, jeeps, guns, planes, boats all get new "facials" often—protective colorings that blend with backgrounds, changing with the seasons or locale. Paint sprayers, powered by dependable Briggs & Stratton gasoline motors, do these jobs quickly.

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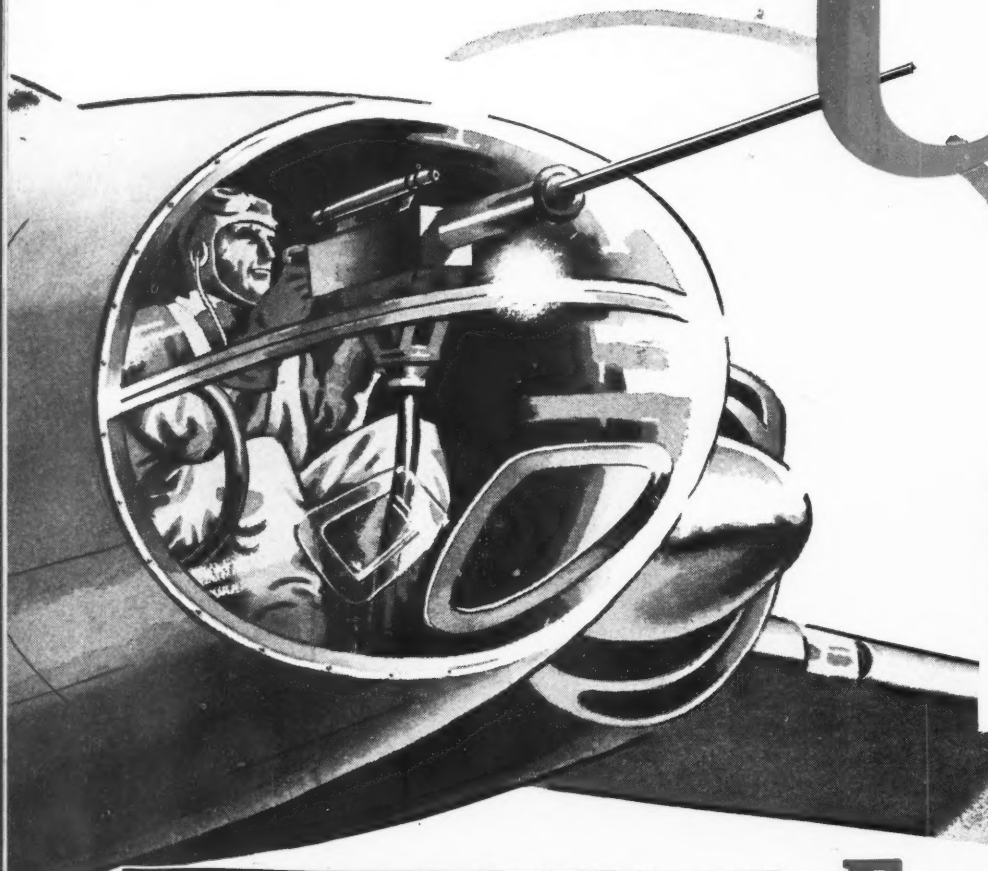
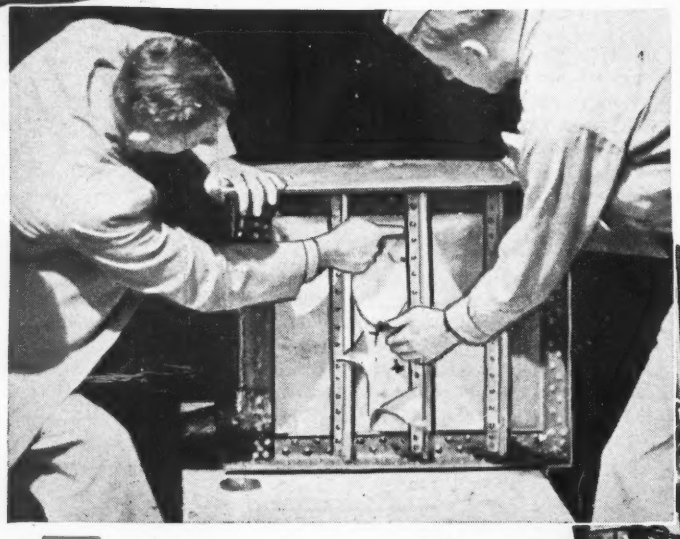


FIRST all-plastic aircraft n used on the Martin B-26, giving b bardier full visibility and absorbing coil of forward gun. Martin was w ing on plastic noses and other part far back as 1921. Today some Ma types contain 400 plastic parts.



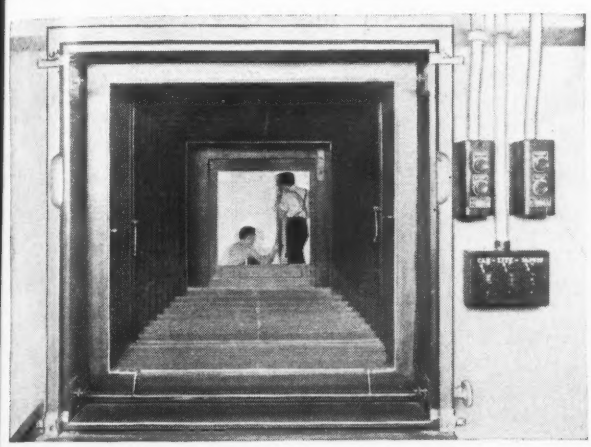
FIRST to develop "heat therapy" for airplane wings. A giant heating "pad" is applied to aluminum covering of wing, expanding this "skin." Riveted when hot, skin shrinks when cool, fits tightly over spars without wrinkling or buckling.

FIRST U. S. self-sealing fuel tank. Martin Mareng tanks are now standard equipment on many American aircraft. Martin experiments on self-sealing fuel tanks date from 1919, during which period more than 285 different materials were tested.

help make

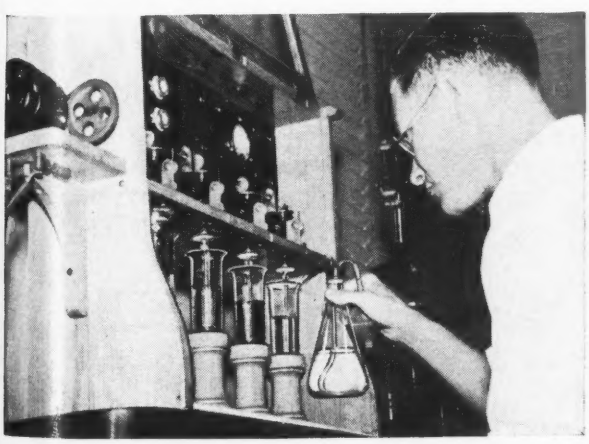
AIRCRAFT

SECOND TO NONE!



FIRST to develop photo-layout method, utilizing giant camera. Through this method, scale photos are reproduced directly on sheet metal, eliminating layout time and speeding production. In addition, drawings may be scaled up or down swiftly, accurately.

FIRST U.S. power-operated gun turrets, giving our bombers strong protection against enemy interceptors. Martin is manufacturing power-driven turrets not only for Martin bombers but also for many other types of American aircraft.



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AIRCRAFT

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These are only a few Martin "firsts." Some are still close-guarded military developments, while numerous others, individually minor but collectively important, are in use throughout the aviation industry to give America better planes and more of them. But Martin engineers are never satisfied. In scores of diverse fields, work goes on to give America even mightier planes for today's aerial fights, tomorrow's peacetime flights.

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Modern air power and pneumatic tools are helping to win the battle of production. Our Service Engineers will gladly help you with your portable tool problem.

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...ven Co.
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...el-McCullough, Inc.
...ectronic Labs., Inc.
...ectronic Specialty Co.
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...ardian Elec. Mfg. Co.
...lf Oil Corp.
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...llory & Co., Inc., P. R.
...nhattan Rubber Div.
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...rdock Co., Wm. J.
...tional Co.
...mite Mfg. Co.
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...ens-Corning Fiberglas Corp.
...noramic Radio Corp.
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...tes Co., The
...ewart-Warner Corp.
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...radio, Inc.
...rcraft Development Co.
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...nolt Motor Co.
...stin Co., The
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...sh Development Co.
...nfield Mfg. Co.
...ll Sons, C. W.
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...lumbia Machy. & Engrg. Corp.
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...rite Plastics, Inc.
...stern Air Devices, Inc.
...ectric Supply Co.
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...ller Aircraft Co.
...llet & Co., W. P.
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...cker Co., A. W.
...nter Engrg. Co.
...dustrial Engrs., Co., Inc.
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...tercontinent Aircraft Corp.
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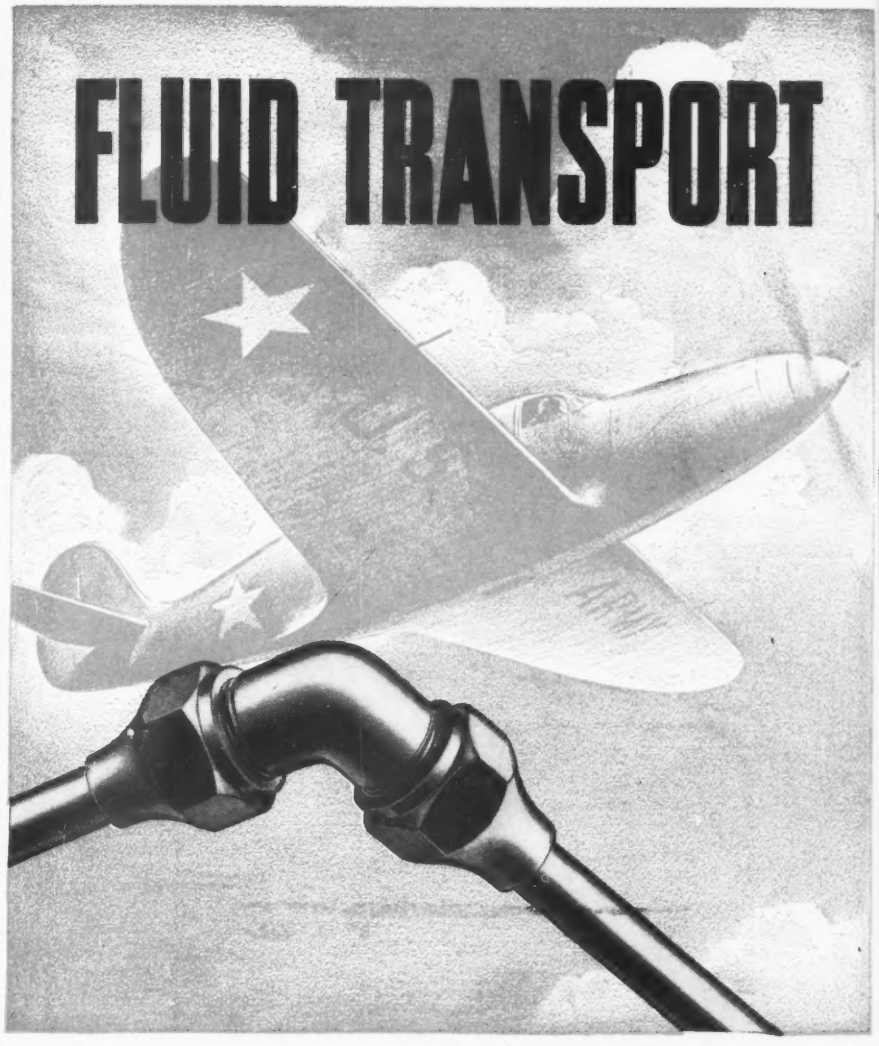

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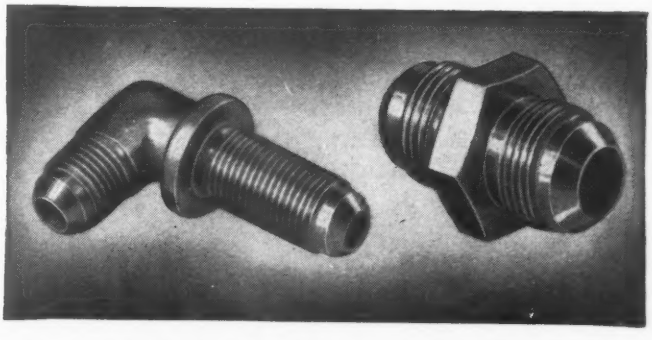
Grinnell production of these fittings for gasoline, oil, air and hydraulic fluids is being constantly increased to help you build air superiority for our forces everywhere. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.



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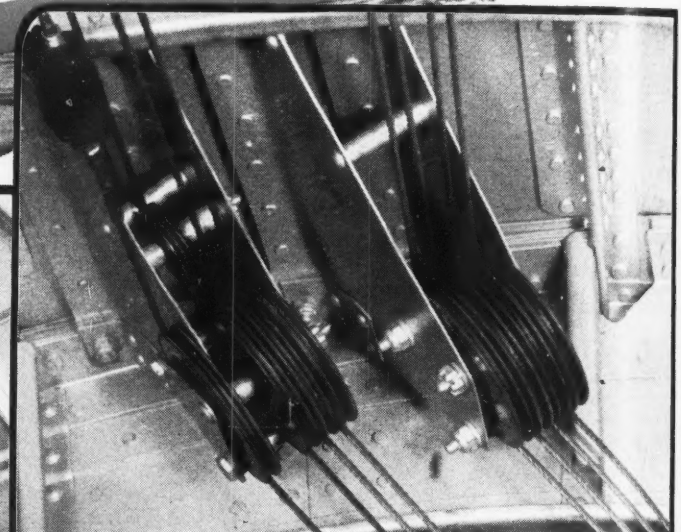
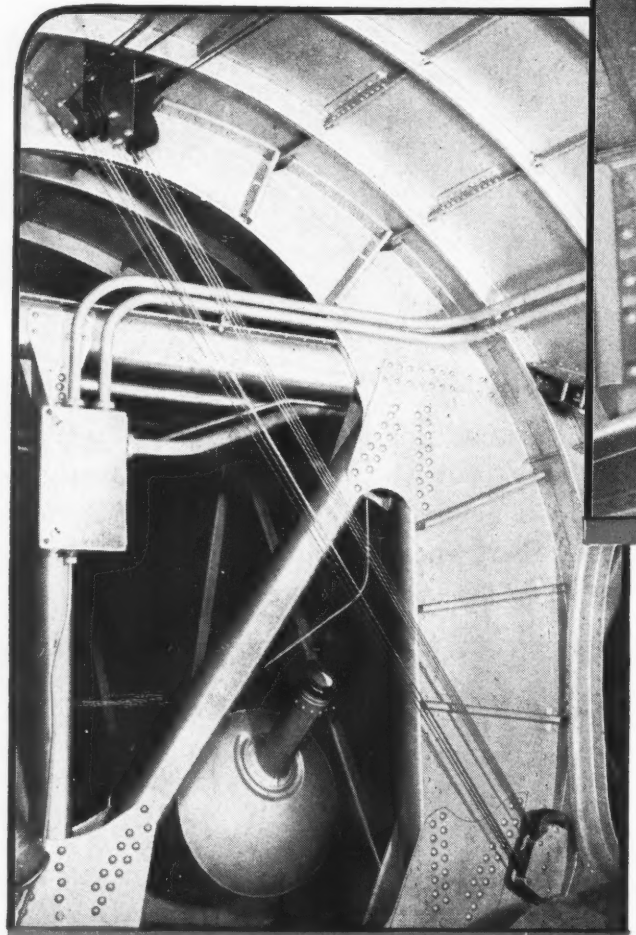
Plants, Branch Warehouses, and Sales Offices in Principal Cities

PAN AMERICAN CLIPPERS fly with FORMICA PULLEYS





The great Clippers flown by Pan American Airways to South America, Europe, Africa, Hawaii, and formerly to Australasia and the Orient, have long been controlled by Formica pulleys. They stand the changes in weather, temperature and humidity and give no trouble.

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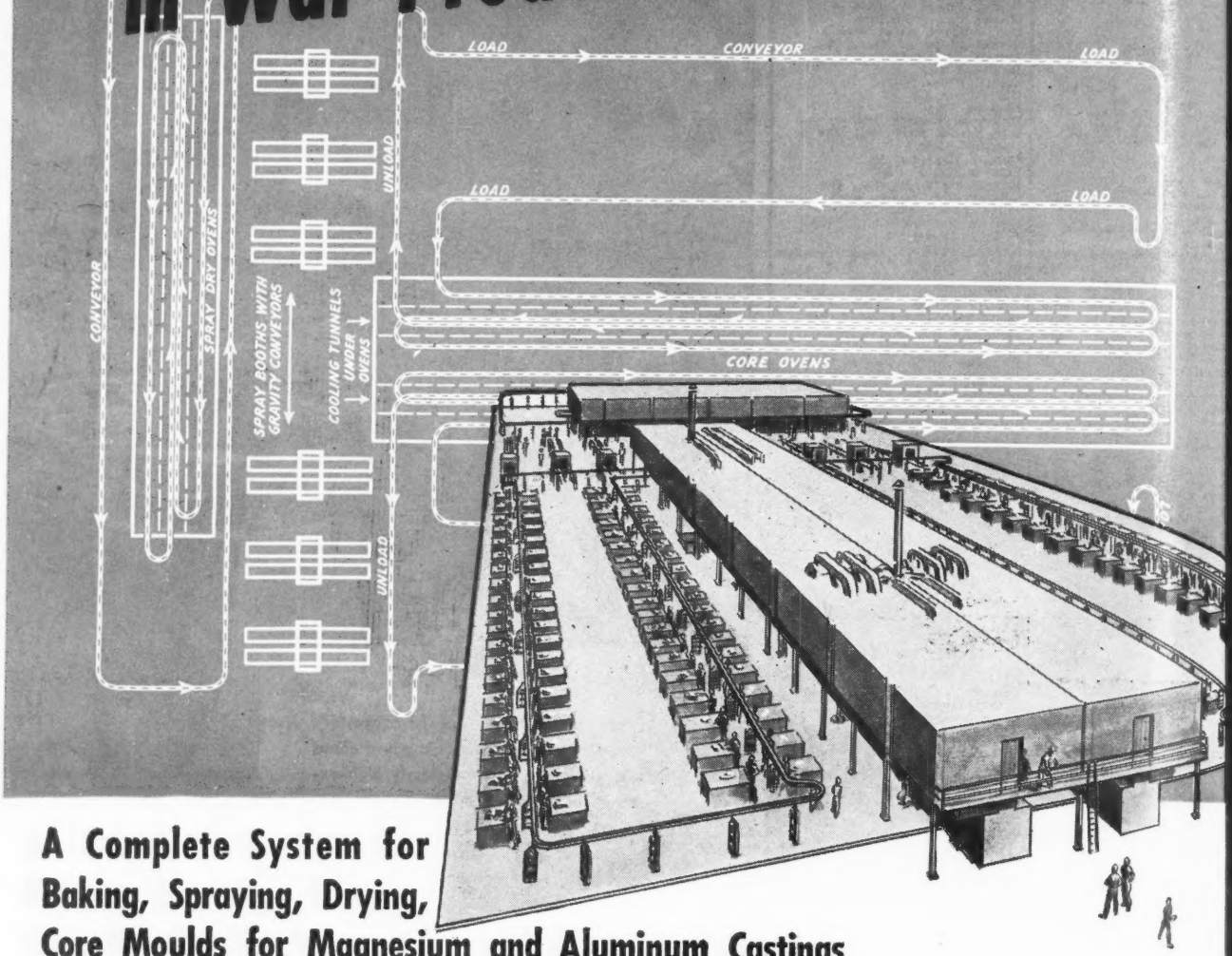

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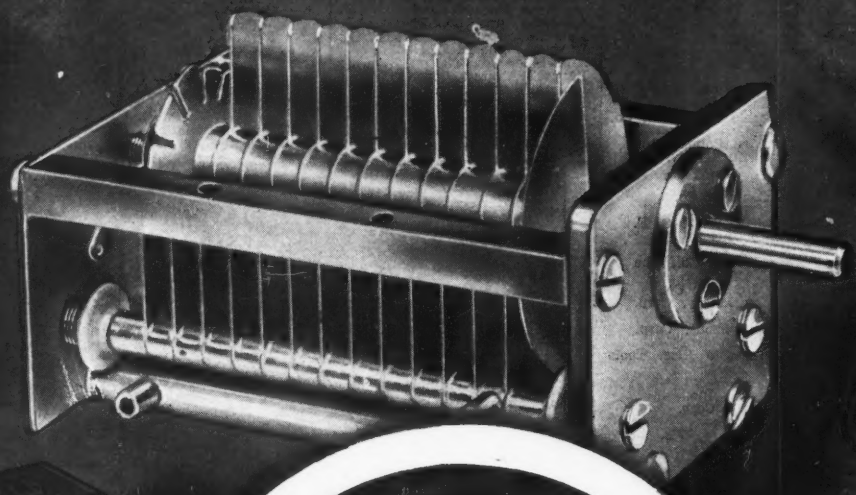

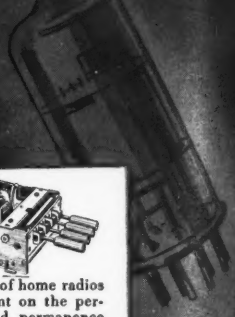

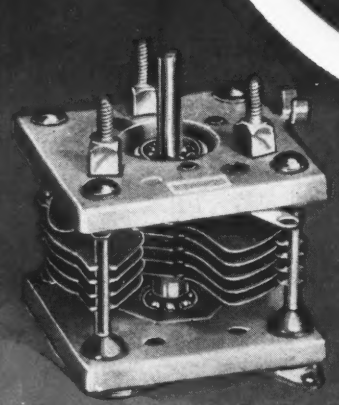

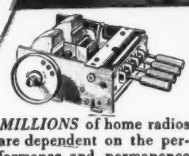

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estinghouse Elec. & Mfg. Co.—(Pa.)
eston Elec. Instr. Co.
icks Organ Co.

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ro Trades Co.
ir Transport Mfg. Co.
ircraft Co., B. H.
ircraft Components, Inc.
ircraft Development Co.
luminum Co. of America
luminum Goods Mfg. Co.
merican Aviation Corp.
ndd Mfg. Co., Edward G.
olumbia Aircraft Industries
etroit Sheet Metal Wks.
I Pont de Nemours & Co., E. I.
ecommon Metals & Supply Co.
ngel Aircraft Specialties
pson Aircraft Corp.
restone Aircraft Co.
lour City Orna. Iron Co., The
uller & Co., W. P.
eneral Tire & Rubber Co.
oodyear Tire & Rubber Co., The
ardman Aircraft Prods., Inc.
arvey Mach. Co.
ayes Mfg. Co.
ndependent Iron Wks.
ngalls Iron Wks. Co.
nternational Engrg. Wks., Inc.
owin, Inc. Metal Prods.
Landers Corp., The
Lester Industries, Inc.
Luscombe Airplane Corp.
Lyon Metal Prods., Inc.
McQuay, Inc.
Mercury Aircraft, Inc.
Morrow Aircraft Corp.
Motors Metal Mfg. Co.
National Radiator Co., The
Neu-Bart Stamping & Mfg. Co.
Poulson & Nardon, Inc.
Presstite Engrg. Co.
St. Louis Aircraft Corp.
Samson United Corp.
Sparks-Withington Co., The
Surface Combustion Div.
U. S. Rubber Co.
Utility Fan Corp.
Virginia Rubatex Divs.
Weber Showcase & Fixture Co.

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Air Transport Equip., Inc.
Applegate Amphibians, Inc.
Bibb Mfg. Co.
Firestone Aircraft Co.
General Tire & Rubber Co.
Goodrich Co., B. F.
Goodyear Tire & Rubber Co., The
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Seiberling Rubber Co., Inc.
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Airdesign & Fabrication, Inc.
Altens Fdry. & Mach. Wks.
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American Transformer Co.
Andrews & Perillo, Inc.
Annis Co., R. B.
Austin Co., The
Auomatic Elec'l Devices Co.
Baldor Elec. Co.
Baldwin Southwark Div.
Barber-Colman Co.
Bath Co., John
Bethlehem Equip. Corp. Ltd.
Biddle & Co., James G.
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Brush Development Co.
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Cambridge Instrument Co.
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Daven Co.
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Denison Engrg. Co., The
Dillon & Co., W. B.
Durant Mfg. Co.
Electric Prods. Co.
Engis Equip. Co.
Exact Weight Scale Co., The
Fairchild Aviation Corp.
Fischer & Porter Co.
Gardner Propeller Co.
General Elec., Refrigerator Div.
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Graybar Elec. Co., Inc.
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Harvey Mach. Co.
Heyer Prods. Co., Inc.
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Instrument Specialties Co., Inc.
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Magnaflux Corp.
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Permutit Co., The
St. John X-Ray Service, Inc.
Saxl Instrument Co., Inc.
Scientific Instr. Co.
Shallcross Mfg. Co.
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States Co., The
Steel Prods. Engrg. Co.
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Sturtevant Co., P. A.
Tagliabue Mfg. Co., C. J.
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Thompson Grinder Co., The
Toledo Scale Co.
Trent Co., Harold E.
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U. S. Testing Co., Inc.
Waite Mfg. Div., Picker X-Ray
Vinco Corp.

TOOLS, HAND

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Aero Tool Co.
Air Associates, Inc.
Aircraft Screw Prods. Co., Inc.
Aircraft Tool & Die Corp.
Aircraft Tools, Inc.
Airsealand Aircraft, Inc.
Albertson & Co.
Altens Fdry. & Mach. Wks.
American Designing & Engrg. Co.
Apco Mossberg Co.
Apex Mach. & Tool Co., The
Apex Tool Co., Inc., The
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WE'VE MADE BILLIONS

—and not one has loosened

THEY'RE on oil well pumps — some for twelve years.

They're standard equipment on rock drills — industry's toughest fastening problem.

They're on tanks, planes, guns—all kinds of wartime material—all kinds of peacetime equipment.

All told, billions of Elastic Stop Nuts have gone to work.

And as far as we know, not one has failed to do its job.

That job is to hold fast and stay put—come what may in the way of vibration, jar or chatter.

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So even at our 4,000,000-a-day rate (which soon will double) the demand keeps growing.

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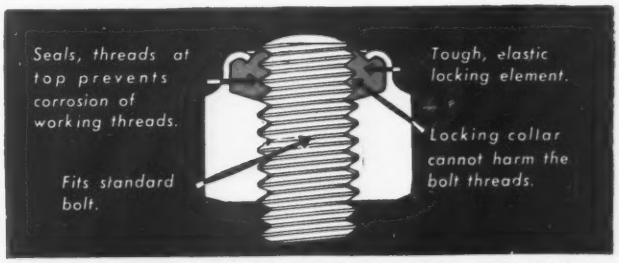
Seals, threads at top prevents corrosion of working threads.
Fits standard bolt.
Tough, elastic locking element.
Locking collar cannot harm the bolt threads.

Write for folder explaining the Elastic Stop self-locking principle.

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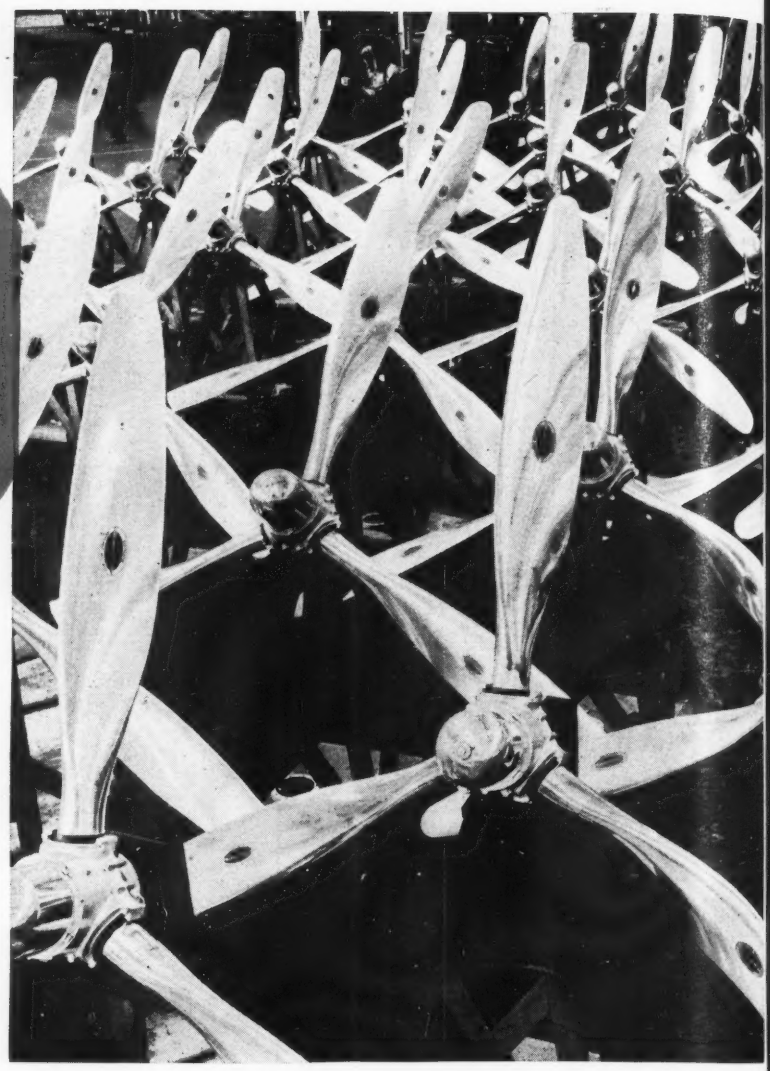

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Waterbury, Conn.

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...ar Mfg. Co., Ind. Div.
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...rtindale Elec. Co.
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...ion Fork & Hoe Co., The
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...iversal Vise & Tool Co.
...n Dorn Portable Elec. Tools
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...chek Tool Co.
...llace Supplies Mfg. Co.
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...lliams & Co., J. H.
...nter Bros. Co.
...dack Elec. Tool Corp.

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Bullard Co., The E. D.
Burke Machine Tool Co.
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Cleveland Tapping Machine Co.
Cleveland Tool Engrg. Co.
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Coast Tool & Engrg. Wks.
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Guilberson Corp., The
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Harvey Mach. Co.
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Use CURTIS AIR HOISTS

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Shown above is an installation of a Curtis "One-Man" Air Hoist used at the loading-end of a cleaner in a malleable foundry. The mill was built by N. Ranshoff, Inc., Cincinnati.

This is but one example of how Curtis Air Hoists perform heavy lifting jobs quickly, easily, and accurately. They reduce worker fatigue, release men for other jobs—particularly important now in these days of skilled labor shortages. In plants throughout the country, Curtis Air Hoists have solved many a tough production and personnel problem.

In the face of urgent demands for increased production today, it will pay you to consider these advantages of Curtis All Steel Air Hoists:

- **Low first cost — low operating expense**
- **Smooth, fast, accurate control of loads**
- **Light weight, pendant, bracketed, or rope compounded types**
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- **One man operation — by ordinary labor**

For complete information as to how you can step up production and lower costs in *your* plant, send for free booklet, "How Air Is Being Used in Your Industry"—mail the coupon today.

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with this new tracing cloth

Here is a tracing cloth that holds erasure scars at a minimum—that won't show water marks or perspiration stains. Now you can have clean tracings, in pencil or ink, free from these untidy "ghosts" that reproduce on blueprints!

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Let PHOENIX prove its virtues on your own drawing board. See your K&E dealer, or write for a generous working sample and an illustrated brochure.

EST. 1867

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PHOENIX DEFIES MOISTURE GHOSTS

Perspiration and water splashes on ordinary tracing cloth create "ghosts" which reproduce on blueprints. PHOENIX Tracing Cloth withstands actual immersion in water for fully 10 minutes at a time! *Perspiration and water marks will not stain it!*

PHOENIX LESSENS SMUDGE GHOSTS

The new improved surface of PHOENIX Tracing Cloth permits you to use harder pencils (5H and 6H) and to get sharper lines with less tendency to smudge.

Result: Cleaner tracings and blueprints.

PHOENIX REDUCES ERASURE GHOSTS

Ordinary tracing cloths become scarred when erased... erased spots produce ghosts on blueprints.

PHOENIX has a durable drawing surface that reduces working scars to a minimum.

K&E

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Norton Co.
Ny-Lint Tool Co.
O. K. Tool Co., Inc., The
Ohio Machine Tool Co., The
Oilgear Co., The
Onsrud Machine Wks., Inc.
Oster Mfg. Co., John
Parker Appliance Co., The
Parker Stamp Works, Inc.
Patrick-McDermott Co.
Paulson Tools, Inc., The
Peck, Stow & Wilcox Co.
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Pines Engrg. Co.
Pioneer Engrg. & Mfg. Co.
Porter Cable Mach. Co.
Potter & Johnston Machine Co.
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Precision Tool & Mfg. Co.
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Production Machine Co.
Products Engineering Co.
Racine Tool & Mach. Co.
Reed-Prentice Corp.
Rivett Lathe & Grinder, Inc.
Robertson Machine & Fdry. Co.
Rodale Mfg. Co., Inc.
Rogers Machine Works, Inc.
Ruthman Machy. Co., The
Sav-Way Tool & Machining Co.
Schauer Machine Co.
Seiden Pneumatic Tool Co.
Service Engraving Co.
Sheffield Corp., The
Slocomb Co., J. T.
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South Bend Tool & Die Co.
Southern Engrg. Co., Inc.
Sparks Mach. Tool Corp.
Standard Electrical Tool Co.
Standard Machinery Co.
Stanley Electric Tool Div.
Star Mach. & Tool Co.
Steelweld Machy. Div.
Stow Mfg. Co.
Strippit Corp., The
Studebaker Mach. Co.
Sundstrand Mach. Tool Co.
Tannewitz Works
Taylor Mfg. Co.
Thompson Grinder Co., The
Tietzmann Engrg. Co.
Tomkins-Johnson Co.
Union Mfg. Co.
U. S. Drill Head Co.
U. S. Hoffman Machy. Corp.
U. S. Tool Co., Inc.
Van Norman Mach. Tool Co.
Van Dorn Portable Elec. Tools
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Walls Sales Corp.
Washington Iron Works
Watson-Stillman Co., The
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Western Mfg. Co.
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Cleveland Tractor Co., The
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Oliver Farm Equipment Co.
Pacific Car & Fdry. Co.
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Altens Fdry. & Machine Wks.
Babcock Aircraft Corp.
Continental Machines, Inc.
Cox & Stevens Aircraft Corp.
J. V. W. Corp.
Kenyon Instrument Co., Inc.
Link Aviation Devices, Inc.
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Weems System of Navigation

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Cardox Corp.
Clark Co., The George P.
Crescent Truck Co.
Economy Engineering Co.
Elwell-Parker Elec. Co.
Ernst Carrier Sales Co.
Ernst, Inc., Chas. K.
Hanson Clutch & Machy. Co.
Howe Scale Co., The
Howell Industrial Truck Co.
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Lyon Raymond Corp.
Ohio Galvanizing & Mfg. Co.
Rapids-Standard Co., Inc.
Revolvator Co.
Rocky Mt. Steel Products, Inc.
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Walter Motor Truck Co.
Wellington Machine Co., The
West Bend Equipment Corp.
Willamette Hyster Co.

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American Brass Co., The
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Arnolt Motor Co.
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Chase Brass & Copper Co.
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Motor Prods. Corp.
Mueller Brass Co.
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Panelyte Div.
Penn Brass & Copper Co., Inc.
Precision Tube Co.
Revere Copper & Brass, Inc.
Reynolds Metals Co.
Steel Forming Corp.
Titeflex Metal Hose Co.
U. S. Rubber Co.
Wells & Co., Inc., A. H.
Winchester Repeating Arms Co.
Wolverine Tube Div.

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Applegate Amphibians, Inc.
Arnolt Motor Co.
Brasco Mfg. Co.
Bundy Tubing Co.
Carpenter Steel Co., The
Everhot Prods. Co.
Globe Steel Tubes Co.
Michigan Seamless Tube Co.
Miller Co., The A. J.
Motor Prods. Corp.
National Tube Co.
Ohio Seamless Tube Co.
Pressed Steel Co.
Service Steel Co.
Steel & Tubes Div.
Steel Forming Corp.
Summerill Tubing Co.
Superior Tube Co.
Timken Roller Bearing Co.
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TUBING, OTHER
Aerial Mach. & Tool Corp.
Aero-Coupling Corp.
Aircraft Instr. Service, Inc.
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American Brass Co., The
American Tube Bending Co., Inc.
Arnolt Motor Co.
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Irvington Varnish & Insulator
Johnson Rubber Co., The
Motor Prods. Corp.
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Panelyte Div.
Penna. Flexible Metallic Tubing Co.
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Pierce Plastics, Inc.
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Bendix Prods. Div.
Briggs Mfg. Co.
Burklyn Co.
Cardinal Corp., The
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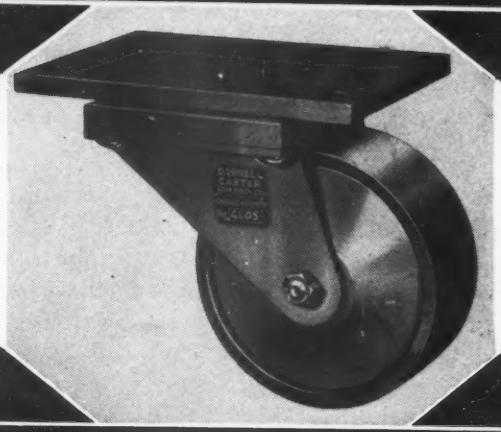

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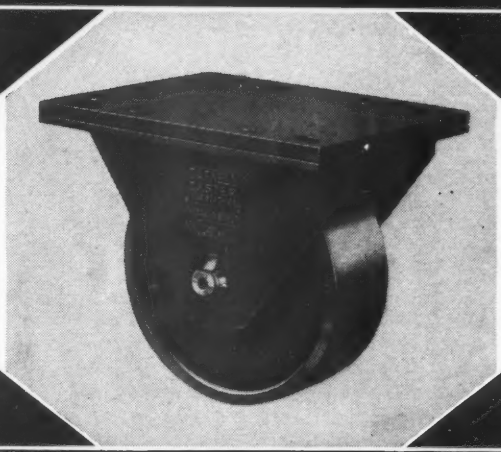

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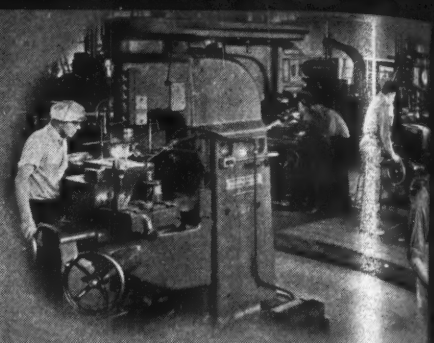

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(Turn to page 315)

Every Flight To and From St. Louis is Cuno Protected

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Builders of today's aircraft have faith in the dependability of Cuno Filters for protecting fluid systems — engine and supercharger lubrication, as well as hydraulic control and glycol heating systems.

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SOME TYPICAL INSTALLATIONS

ENGINE LUBE OIL: Cuno Auto-Klean strains full flow of engine lubricating oil. Filter built in as an integral part of engine — self-cleaning in flight — no external connections.

SUPERCHARGER LUBE OIL: Supercharger bearings are protected against oil borne particles by a Cuno Auto-Klean which filters oil taken from main engine system before passing it to the supercharger.

HYDRAULIC CONTROL SYSTEM: Cuno Auto-Klean, installed in high pressure line beyond the engine driven pump, prevents damage or clogging of working parts in hydraulic control system.

GLYCOL HEATING SYSTEM: Glycol—from storage tank — passes through exhaust heater and cabin heat exchangers to provide hot water and galley heat for cooking. Cuno Auto-Klean filters glycol at 270°F. — protects working parts, prevents accumulation on heat exchanger tubes.

KEEP FLOW ON "GO" WITH

CUNO

THE "FILTER-FINE" STRAINER

Production Doubled

...ON SHRINK FIT ASSEMBLY OF AIRPLANE LANDING STRUTS!

COMPANY NAMES STARTING WITH C*

increased production

Case Study from the Files of Deepfreeze

The Sub-Zero Method of Shrinking, Testing and Treating of Metals

**Name on request to bona-fide inquiries*

Data and Part Information

Shrink-fit assembly of aircraft landing struts.

Diameter of bore—4.843" ± .002".

Diameter of mating part—4.843".

Deepfreeze metal chilling assures permanent assembly —reduces cost

These airplane landing struts, requiring a permanent shrink-fit, were formerly assembled in 20 minutes including heating time. This was done by heating the female part only.

With the installation of a Deepfreeze Cascade Industrial Unit, in conjunction with heating, the time has been reduced to 10 minutes—rejects minimized.

HOW IT'S DONE

The female part is heated in an oil bath at 450° F. and expanded .005". The male part is shrunk .003" in a Deepfreeze Cascade —120° F. Chilling Unit. The time in oil bath is 5 minutes—time in Deepfreeze 5 minutes. The cooling time to room temperature, in a jig, is 5 minutes—total 10 minutes. They are then inspected and wheel spindle must indicate within .003".

HOW DEEPFREEZE CAN HELP YOU...Deepfreeze sub-zero temperatures (as low as —120° F.) can help you in any one or all three of the following metal working operations:

1—Shrinking of metals for ease of bearing assembly, etc.

2—Testing of metals for reaction of sub-zero temperatures to aircraft instruments, etc.

3—Treating of metals for preventing growth or warp in gauges, etc.

FREE Additional Data *and proof of the outstanding success of the Deepfreeze method for chilling metals are included in this booklet. Write for your copy today.*

REQUIREMENTS

To obtain a *permanent* shrink-fit assembly of airplane landing struts.

DIFFICULTIES

Former method by heat only, unsatisfactory—could not hold even temperature. Too many rejects requiring pulling apart or disassembly.

Other Difficulties . . .

Dry ice was too costly, took too much time to crack and prepare...would not handle present production requirements.

SOLUTION

The Deepfreeze Cascade —120° F. Unit used in combination with an oil bath for mating part, meets every requirement, doubles production.

SAVINGS

In addition to savings in time, new method saves approximately $30.00 per day—cost of dry ice.

Deepfreeze

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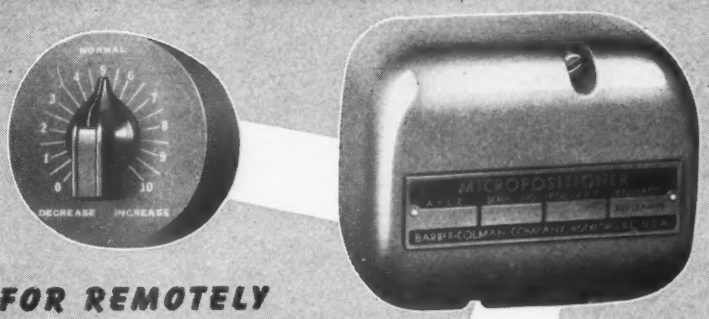

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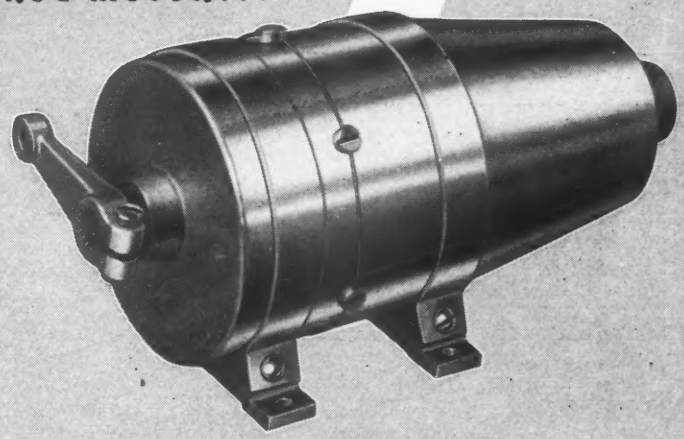

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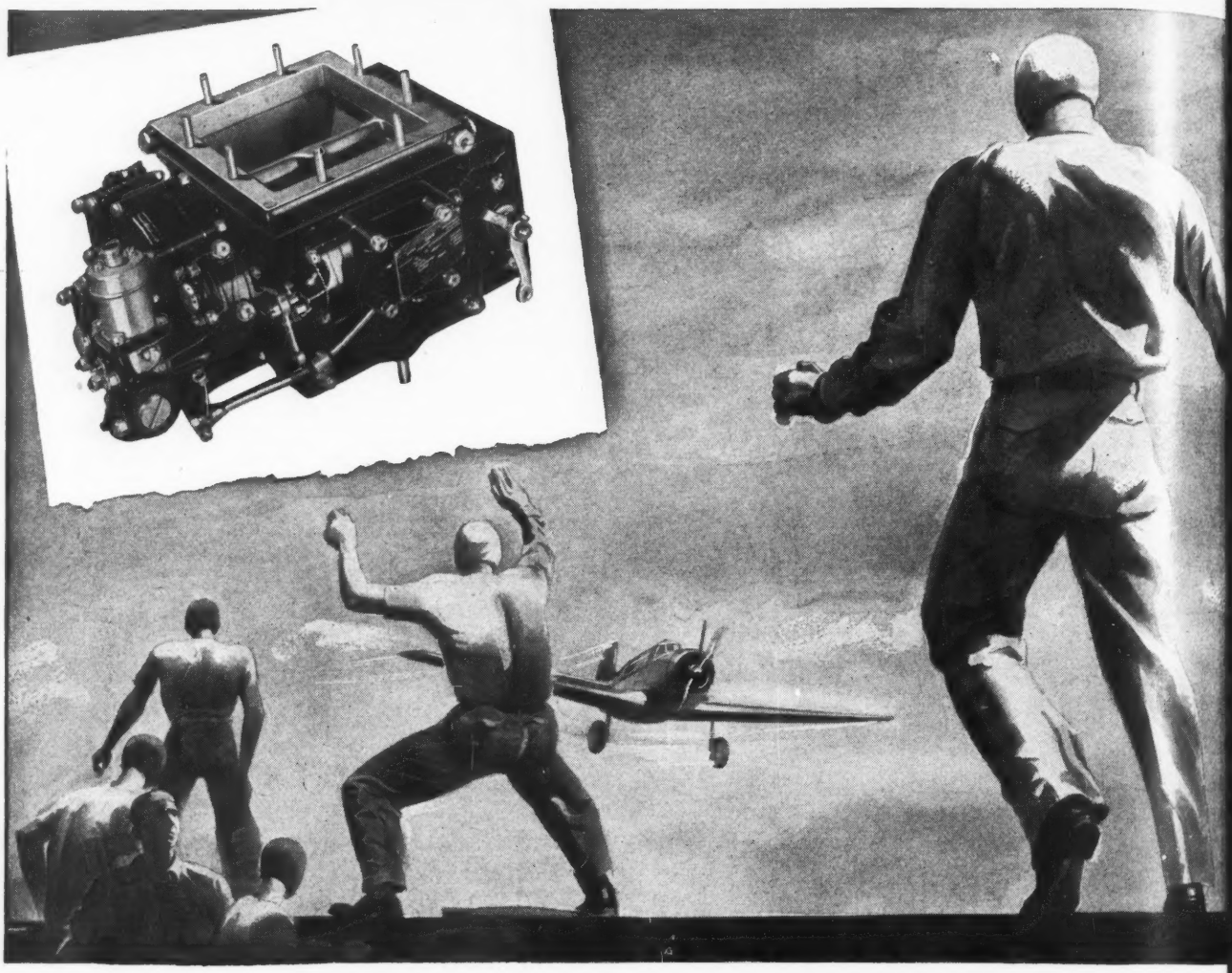

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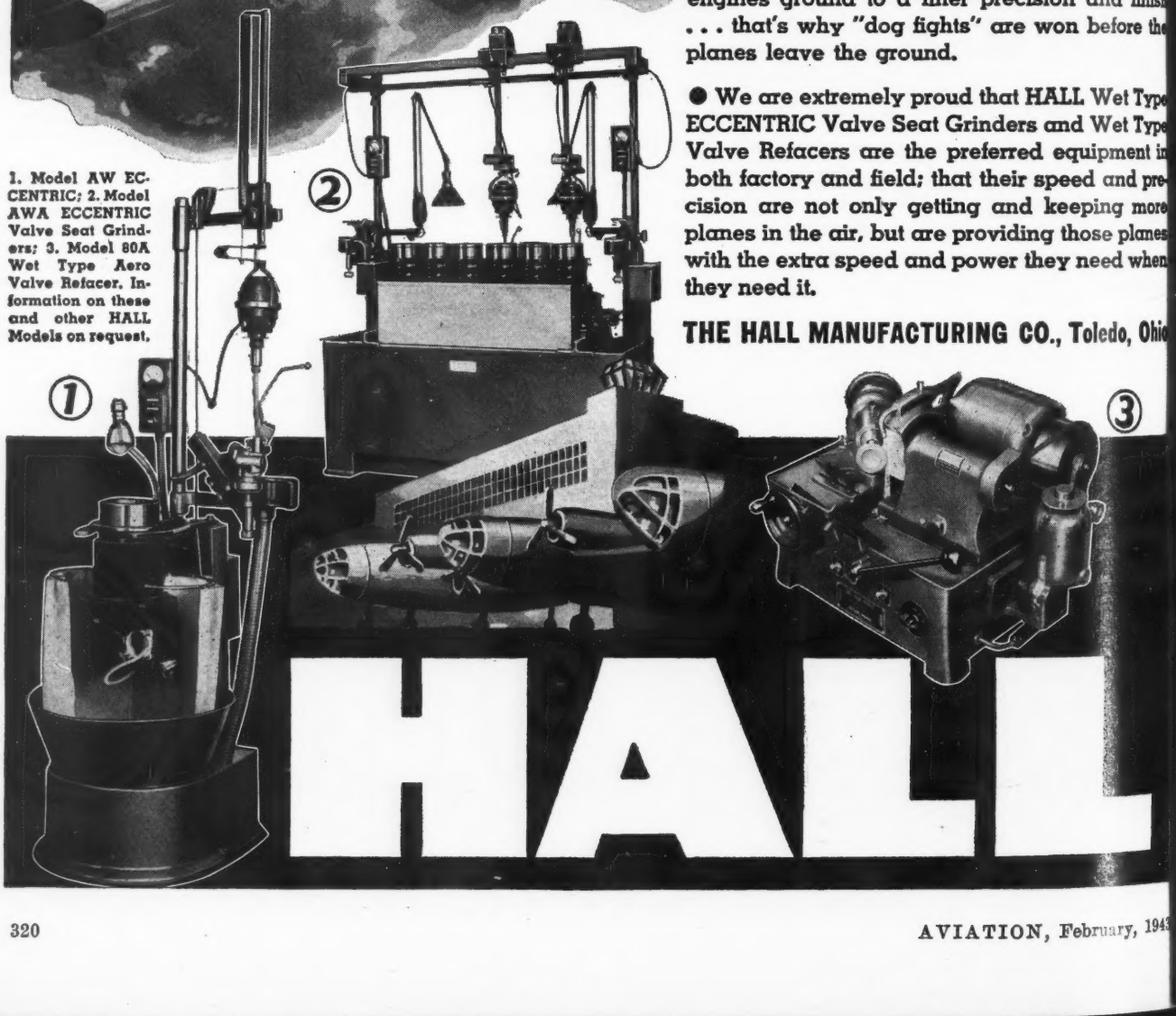

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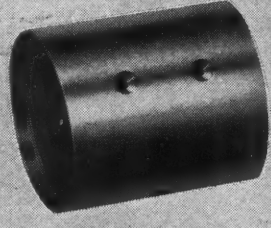

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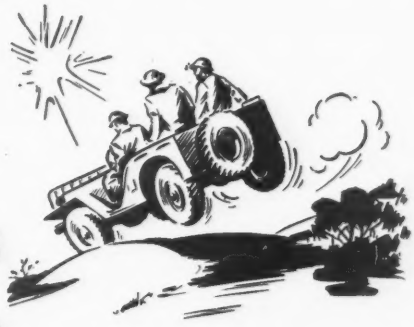

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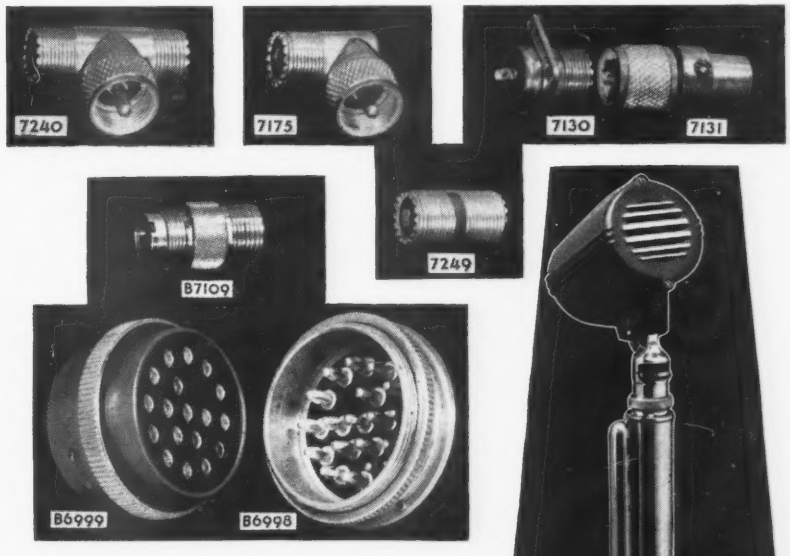

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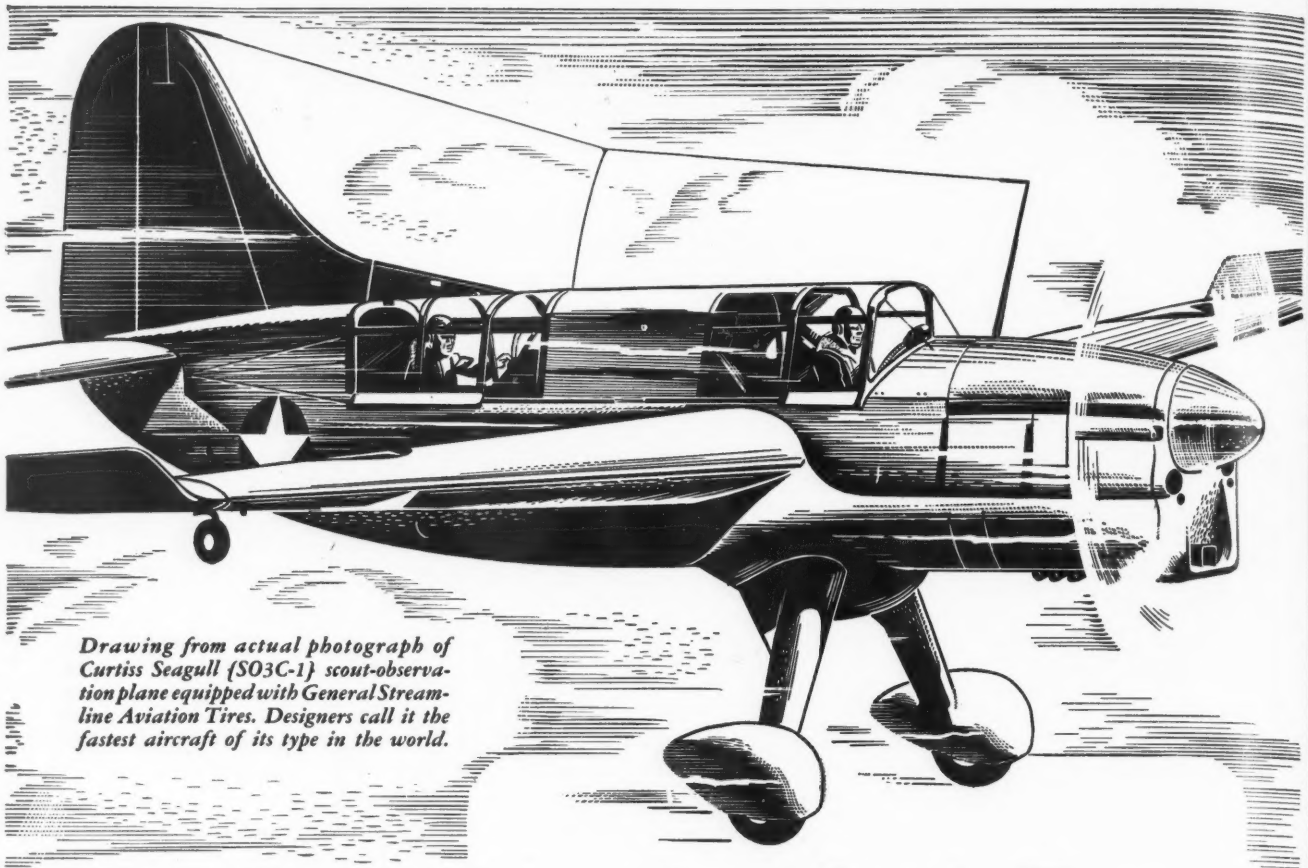

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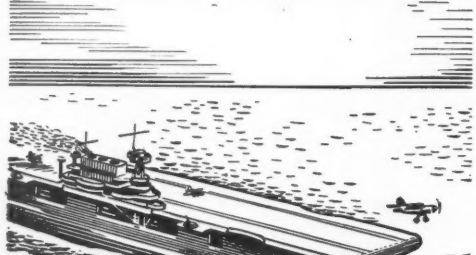

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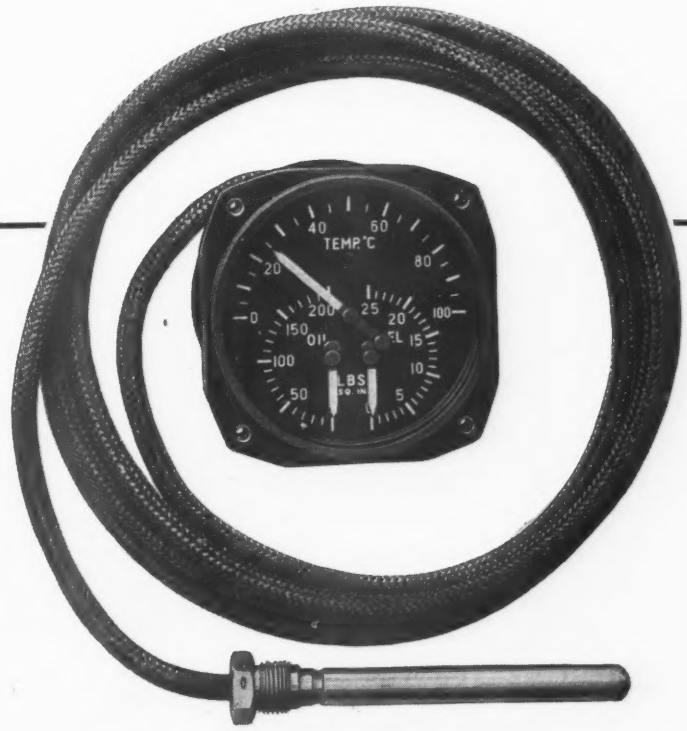

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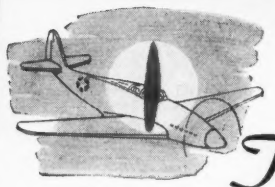

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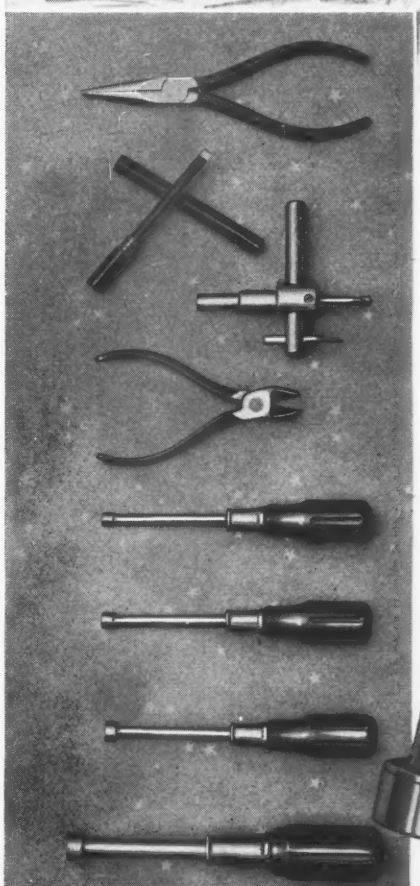

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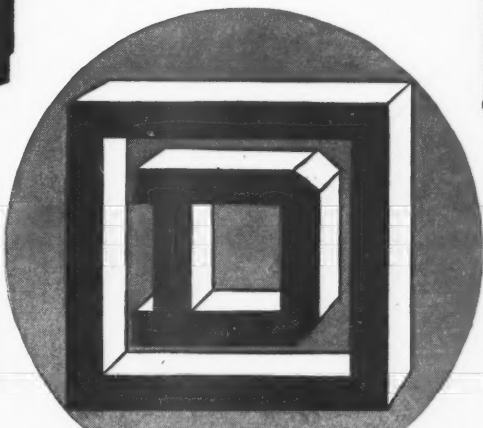

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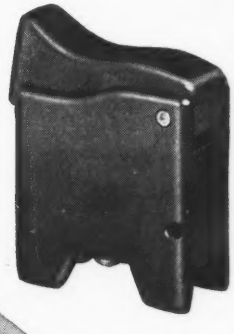

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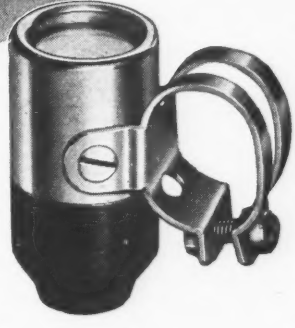

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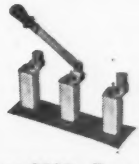

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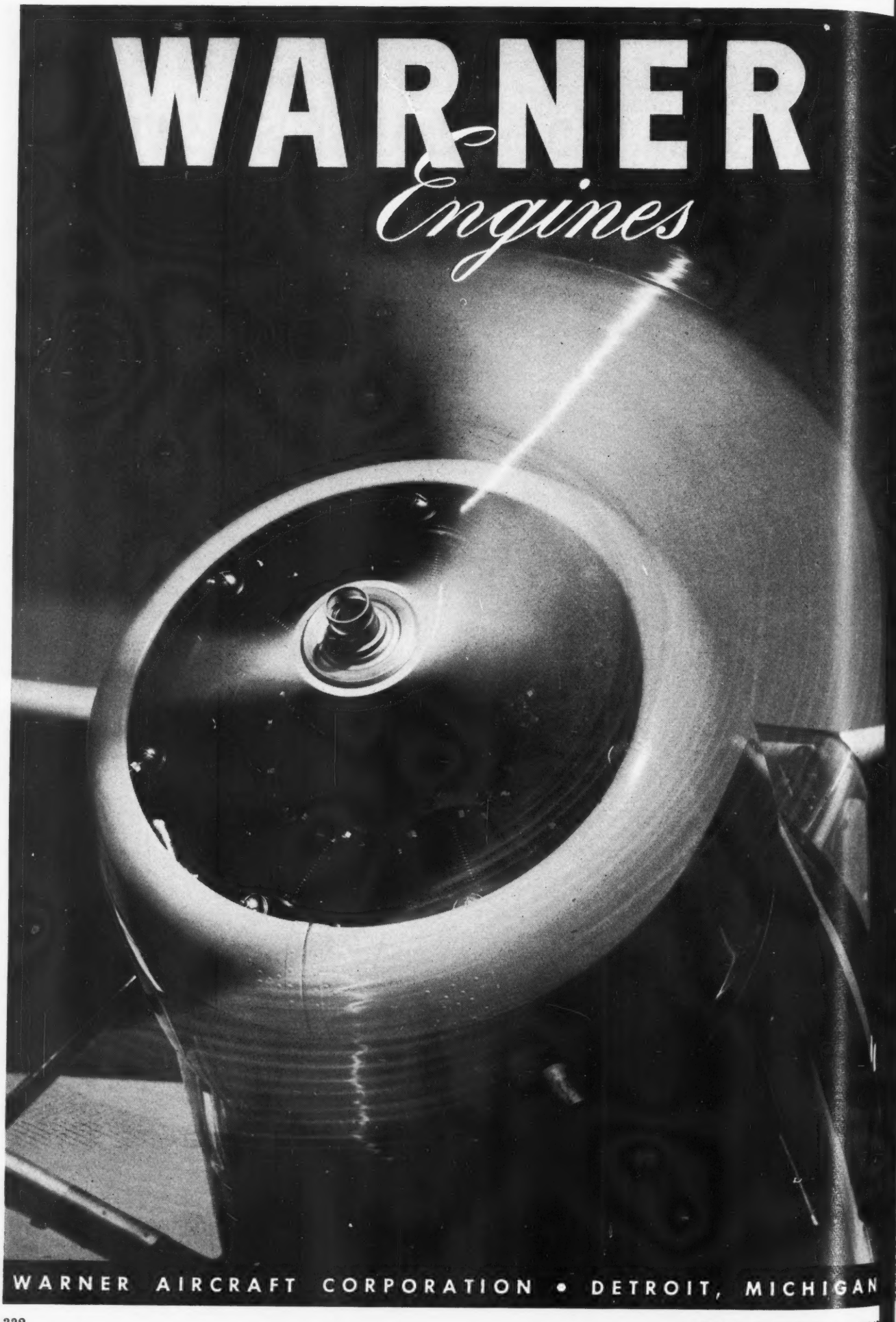
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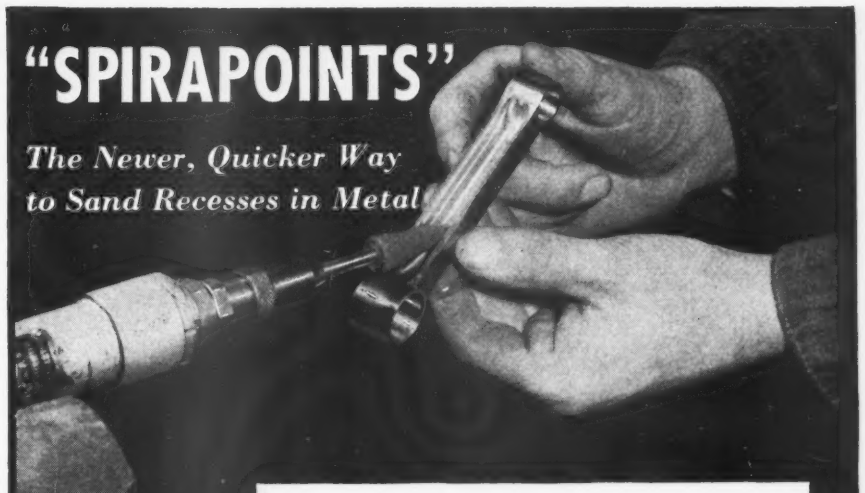

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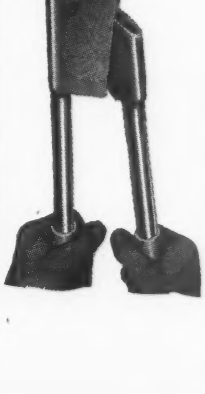

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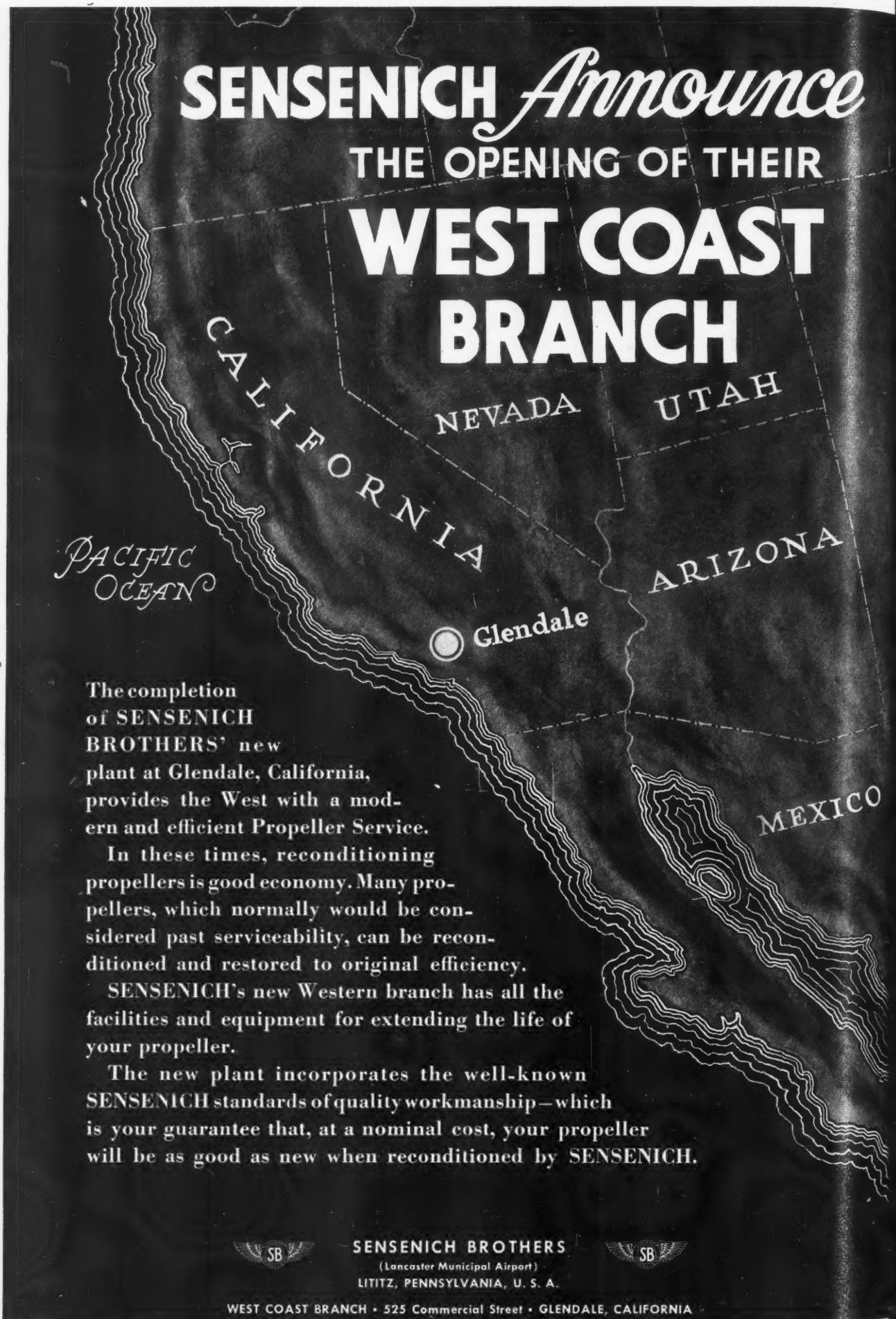

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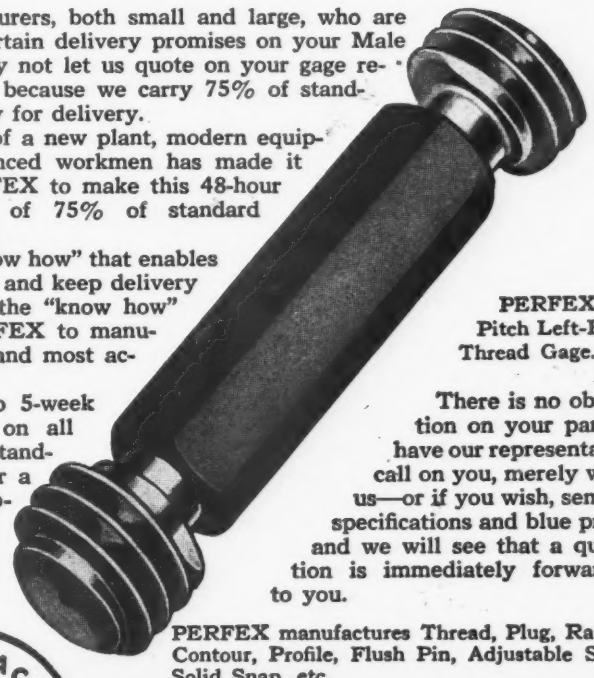

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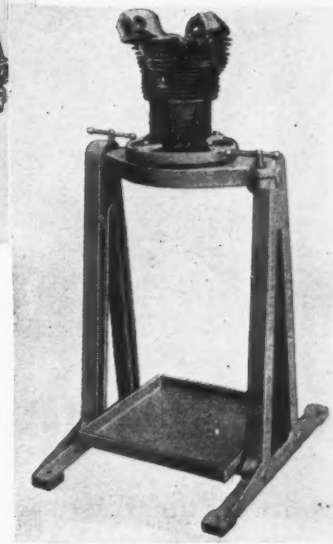

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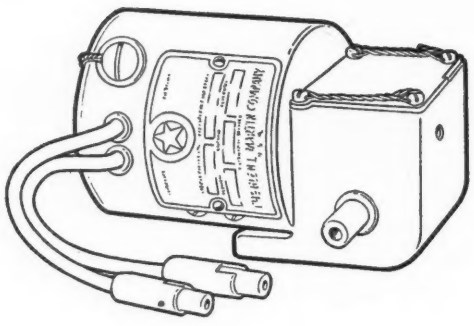

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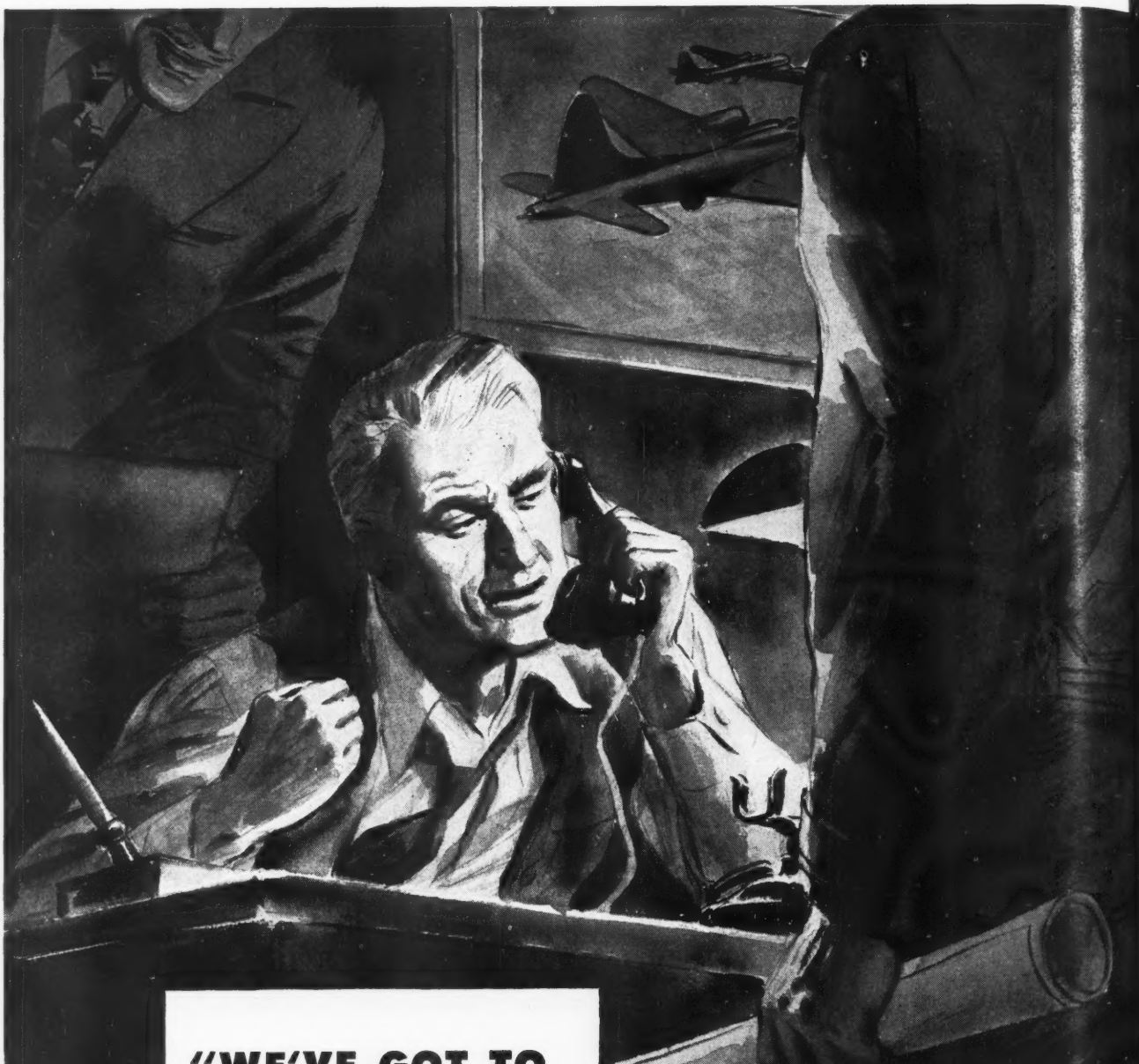

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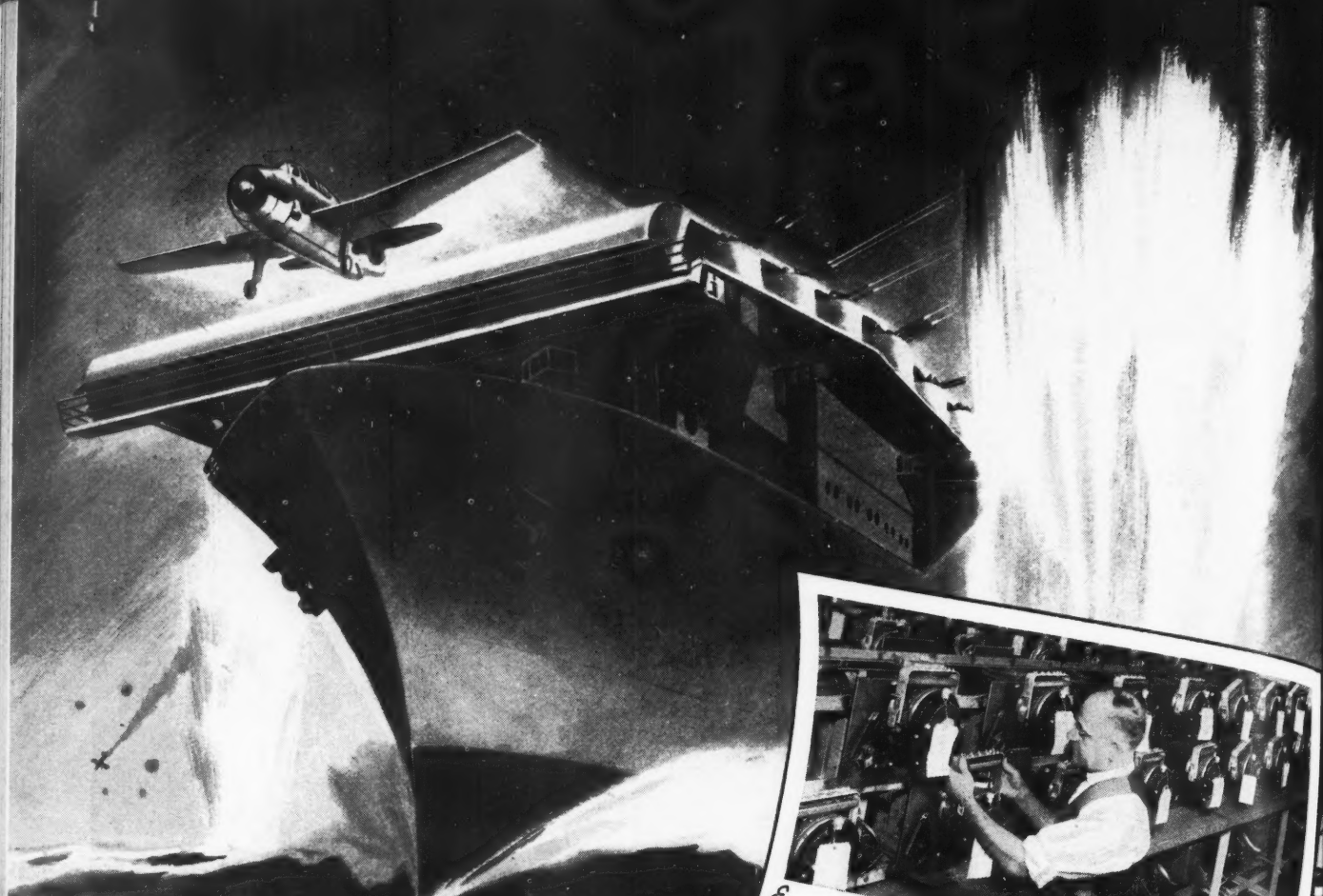

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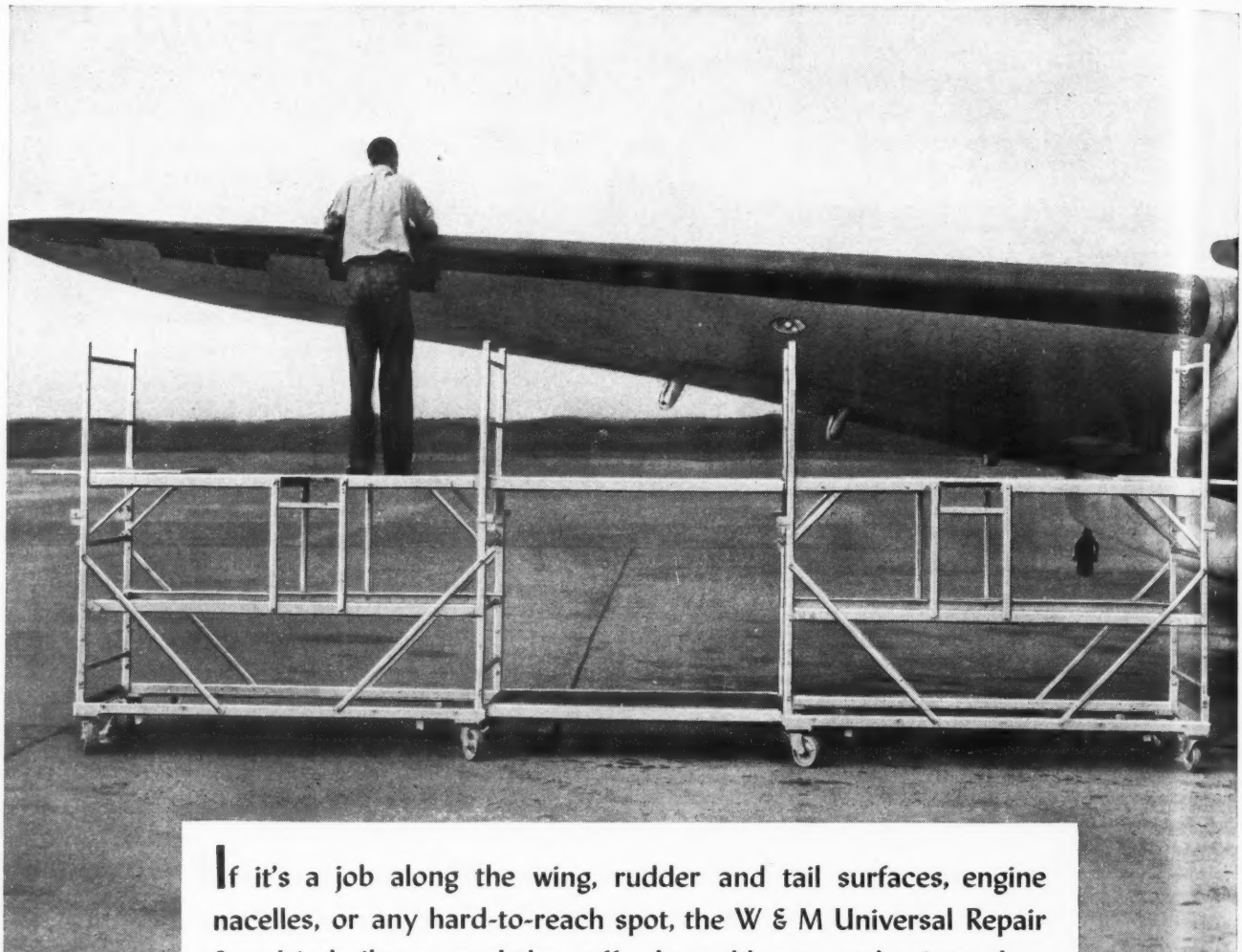

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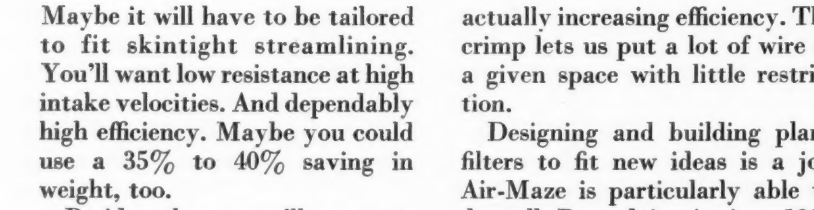

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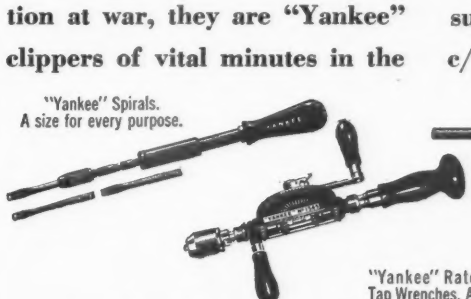

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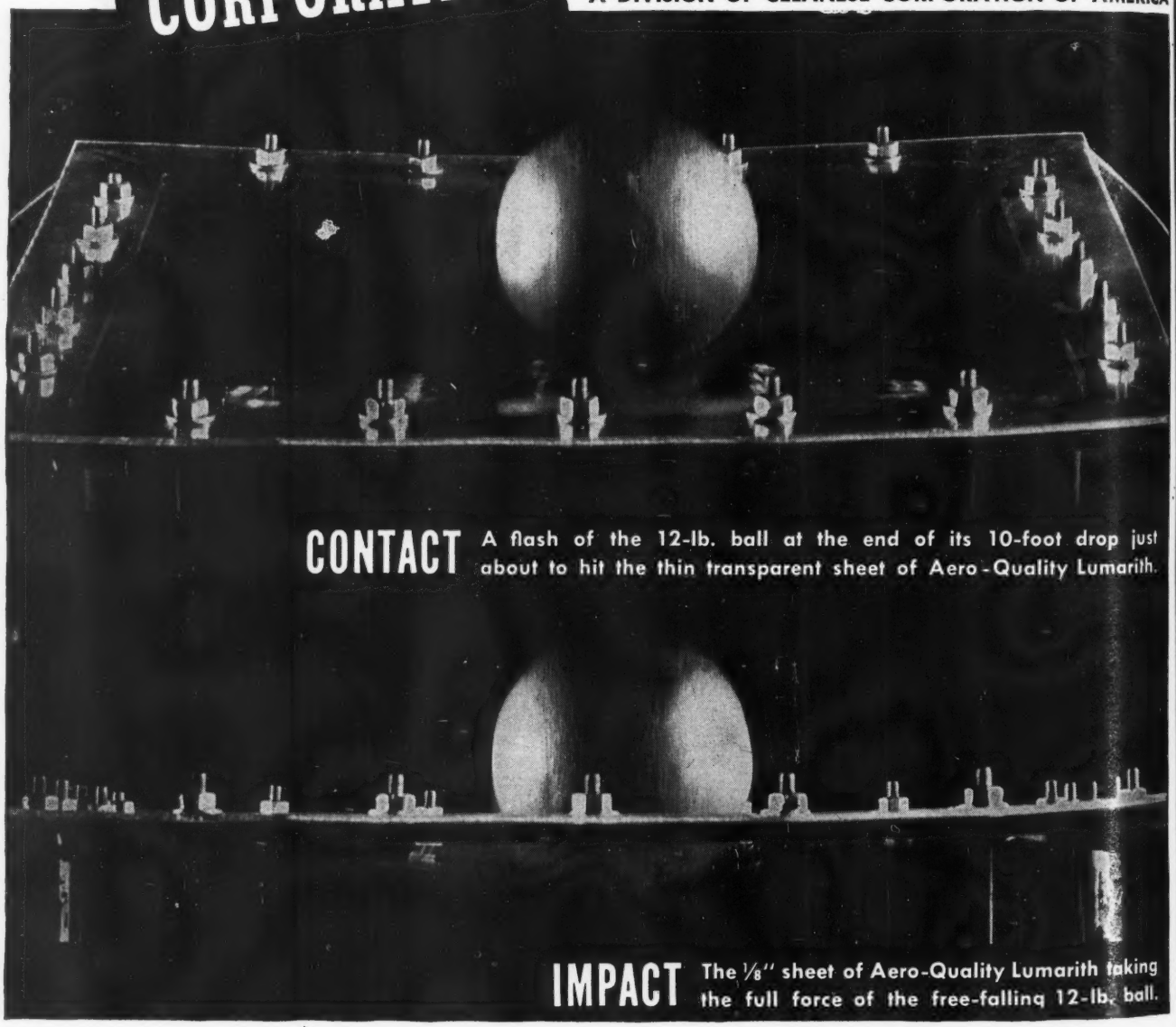

CONTACT A flash of the 12-lb. ball at the end of its 10-foot drop just about to hit the thin transparent sheet of Aero-Quality Lumarith.

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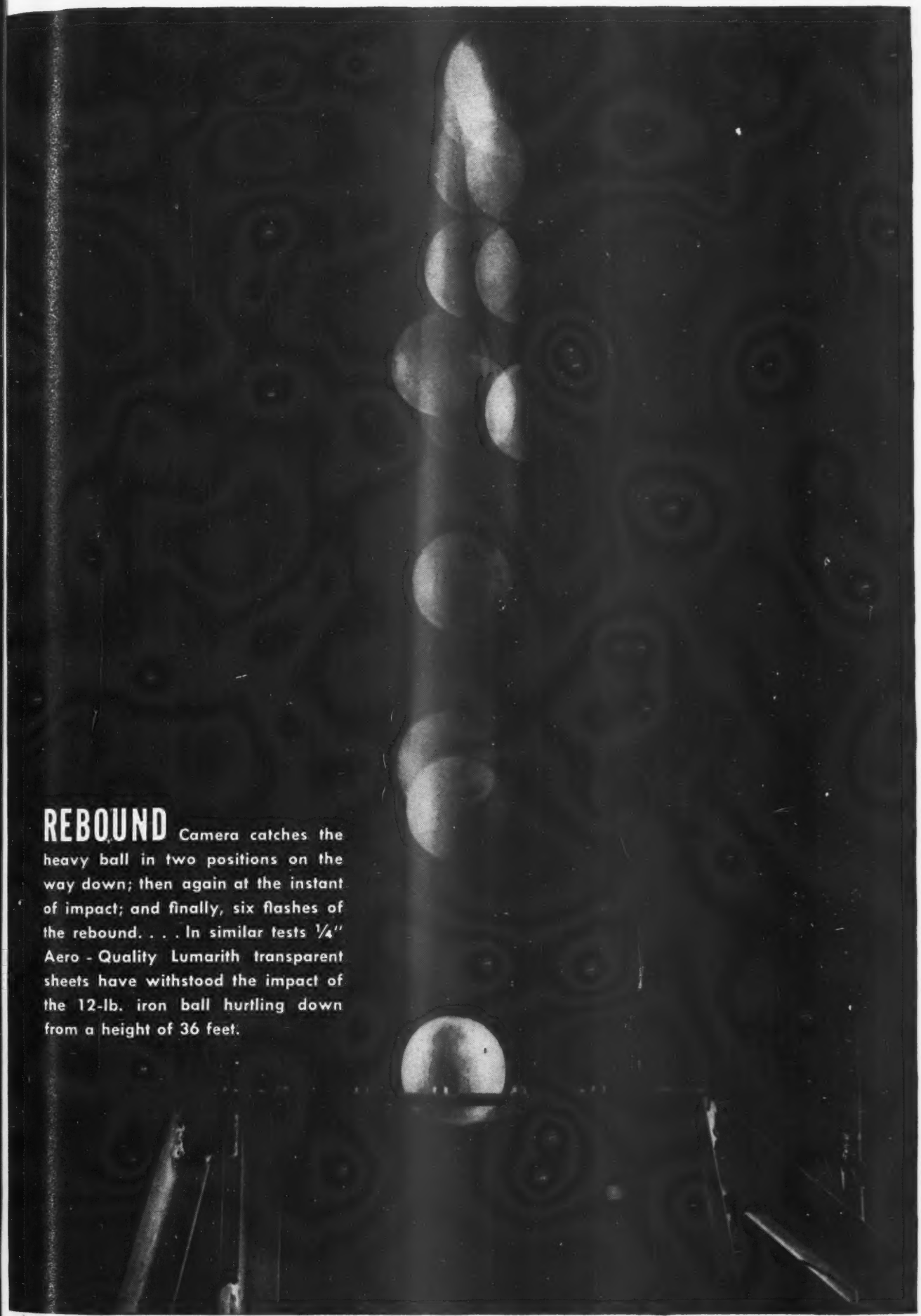

REBOUND Camera catches the heavy ball in two positions on the way down; then again at the instant of impact; and finally, six flashes of the rebound. . . . In similar tests ¼" Aero - Quality Lumarith transparent sheets have withstood the impact of the 12-lb. iron ball hurtling down from a height of 36 feet.

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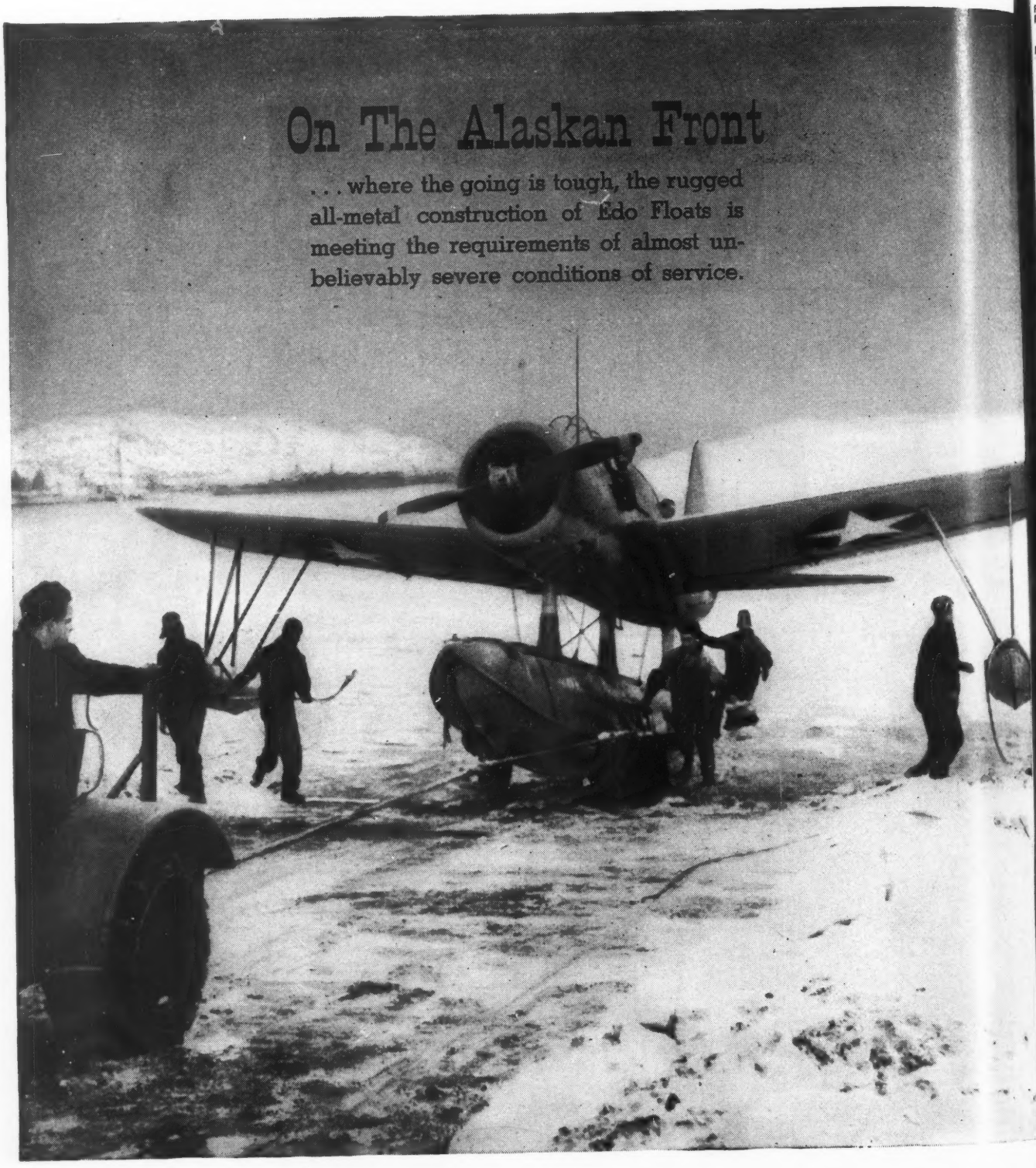
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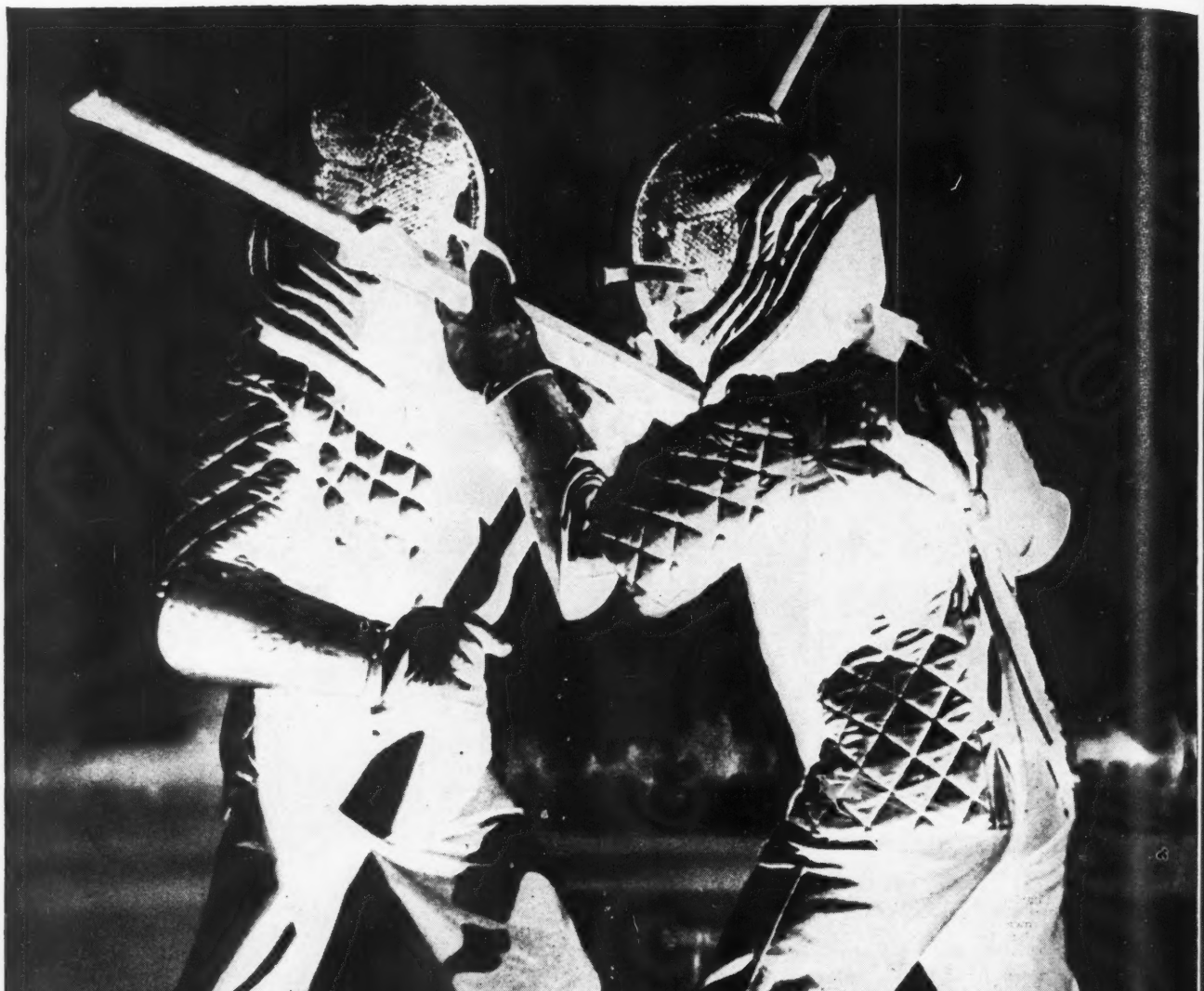

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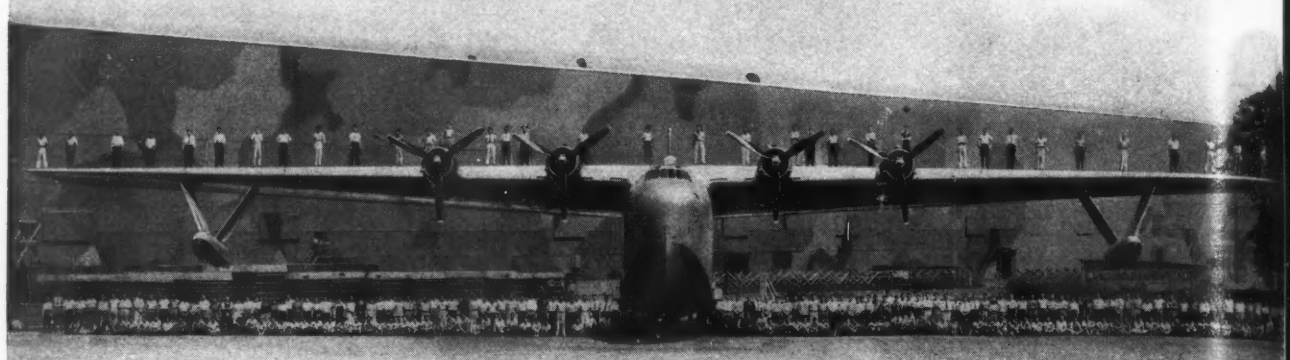

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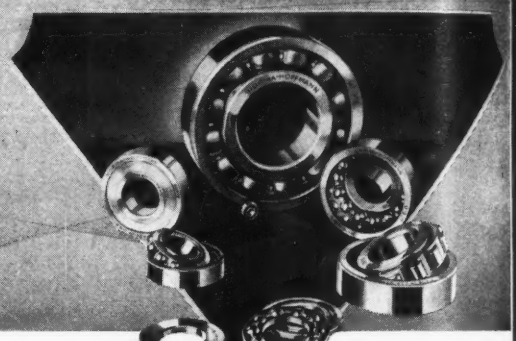

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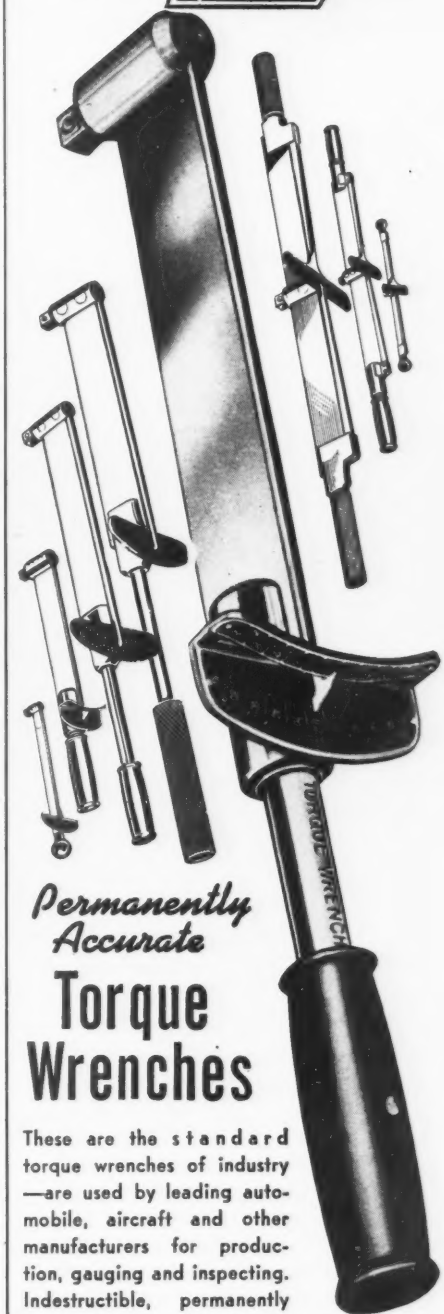

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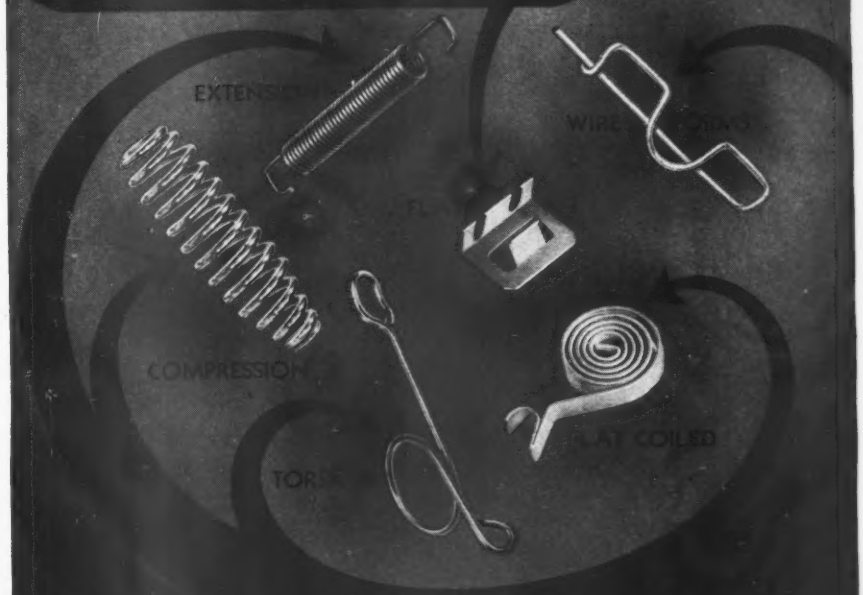

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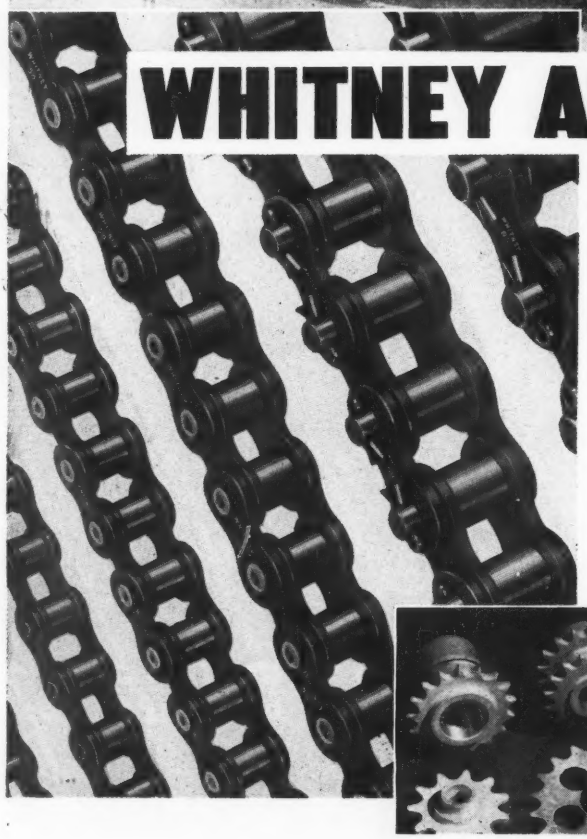

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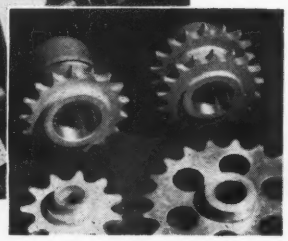

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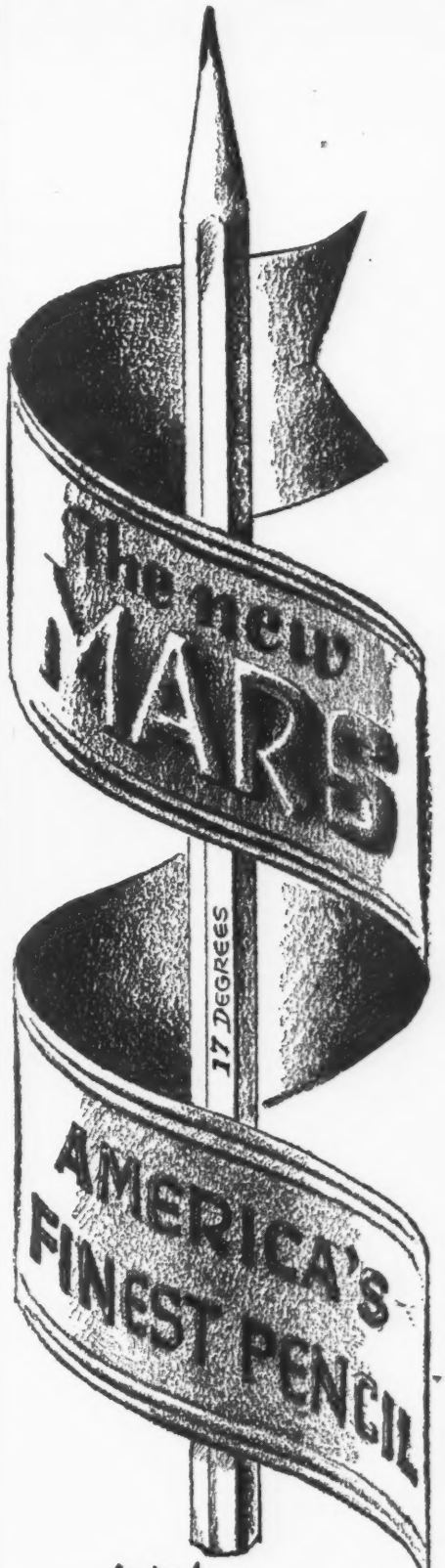

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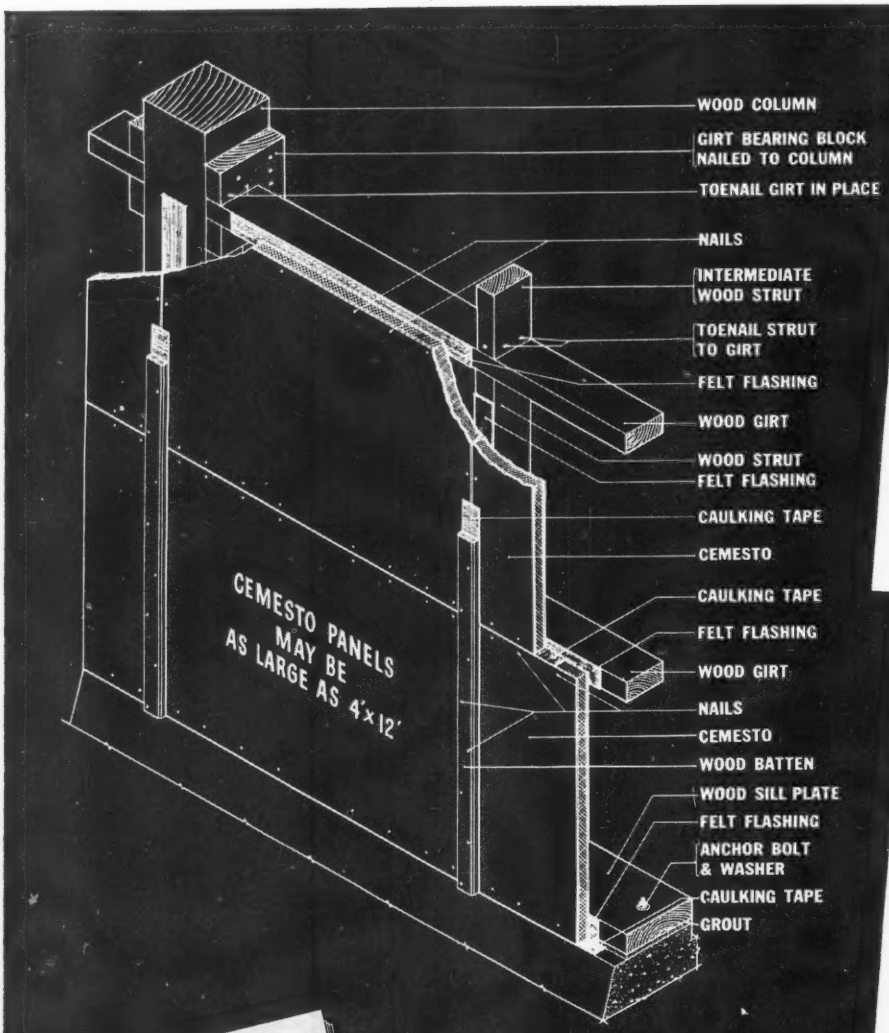

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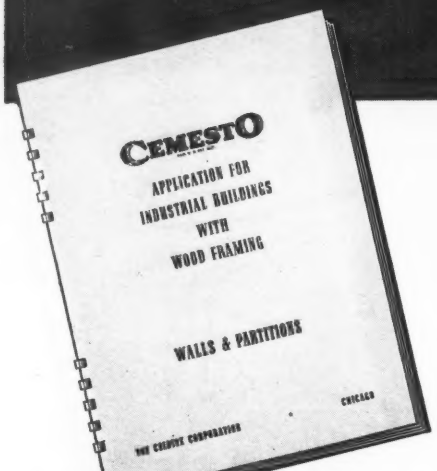

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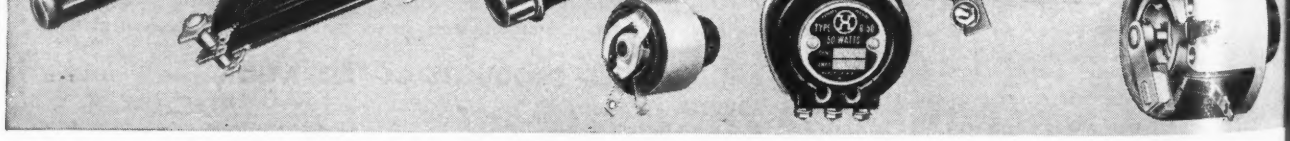

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(Turn to page 379)

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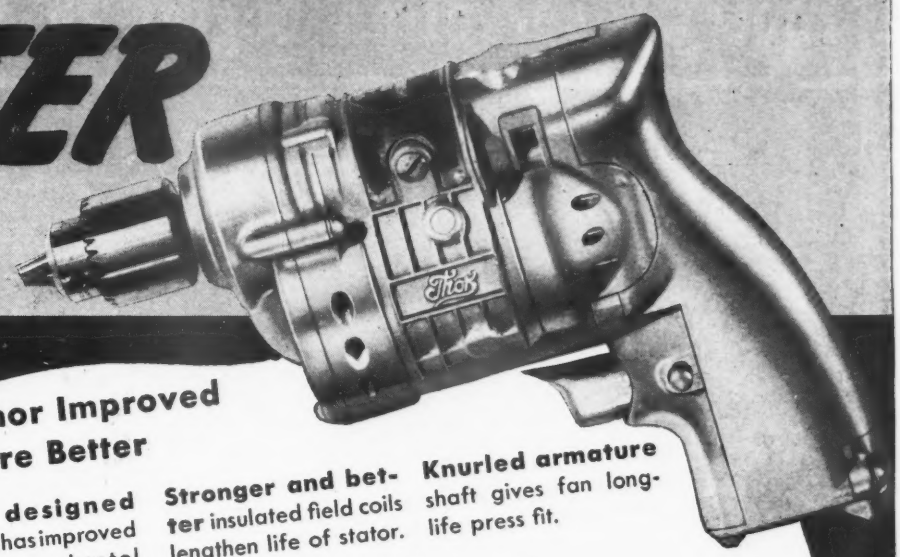


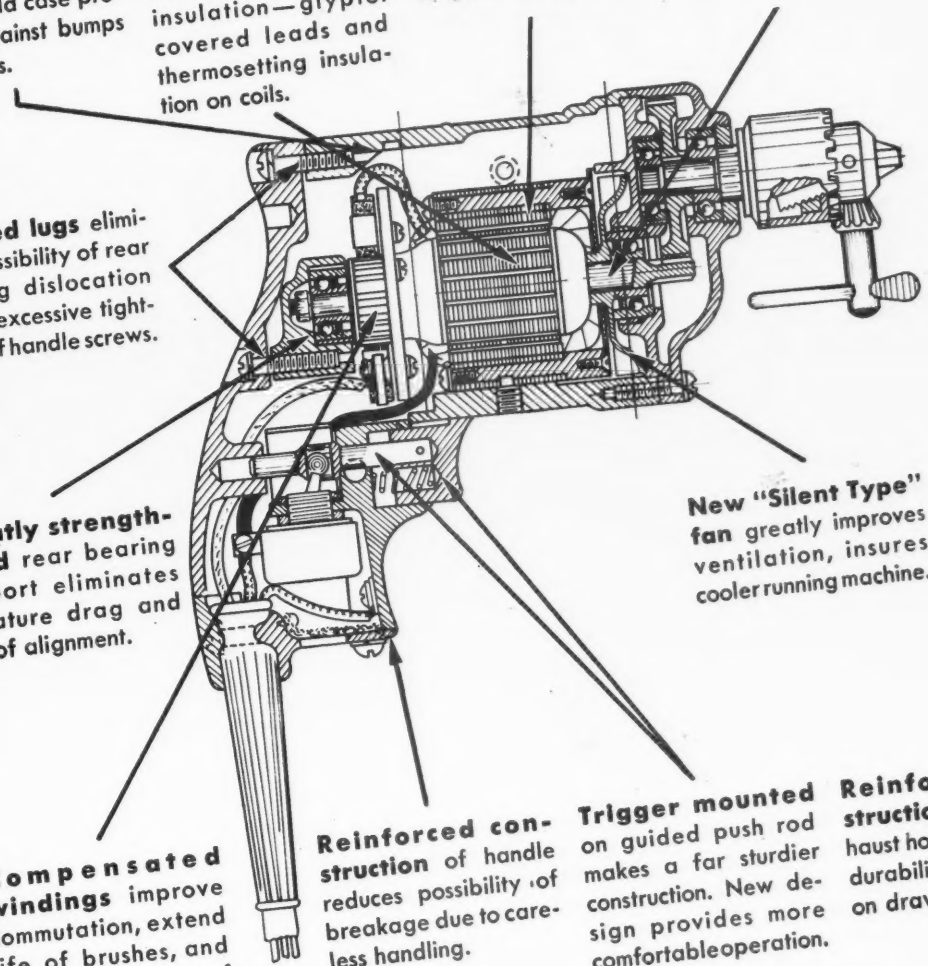
11 Specific Ways Thor Improved U14A Drills Are Better

Sturdier construction of field case protects it against bumps and shocks.

Newly designed armature has improved insulation—glyptol covered leads and thermosetting insulation on coils.

Stronger and better insulated field coils lengthen life of stator.

Knurled armature shaft gives fan long-life press fit.



Matched lugs eliminate possibility of rear bearing dislocation due to excessive tightening of handle screws.

Greatly strengthened rear bearing support eliminates armature drag and loss of alignment.

New "Silent Type" fan greatly improves ventilation, insures cooler running machine.

Compensated windings improve commutation, extend life of brushes, and raise efficiency of motor.

Reinforced construction of handle reduces possibility of breakage due to careless handling.

Trigger mounted on guided push rod makes a far sturdier construction. New design provides more comfortable operation.

Reinforced construction around exhaust holes for greater durability. (Not shown on drawing.)

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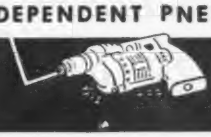

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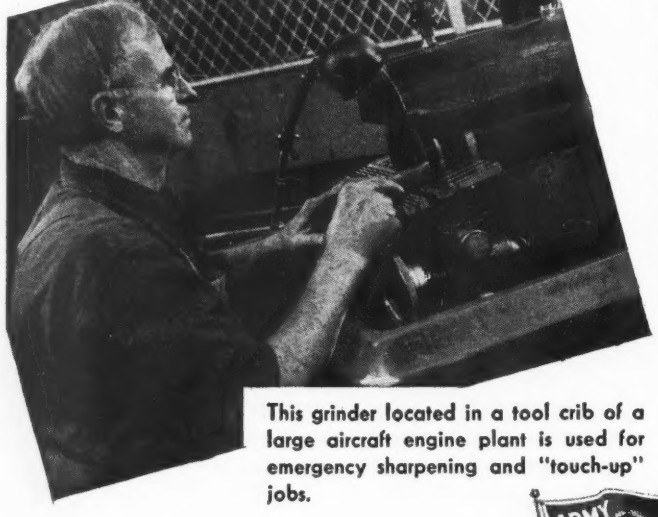
This Tool Sharpening Department under the supervision of an experienced tool engineer assures that every tool in the plant's cribs is in excellent condition.

GET ALL THE *Good* OUT OF *Good Taps*



This grinder located in a tool crib of a large aircraft engine plant is used for emergency sharpening and "touch-up" jobs.

Maintenance of tools in proper working condition multiplies their life many times. Even those which have become badly worn, rusted or chipped — that seem to have outlived their usefulness — may often be salvaged to give valuable additional service.

Many large plants maintain separate tool sharpening and salvage departments. But the small shop or departmental tool crib may easily do an outstanding job if equipped with a small grinder and a few attachments.

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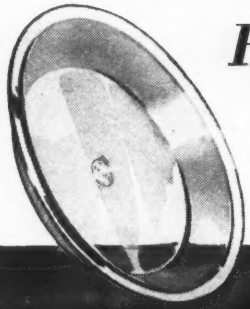

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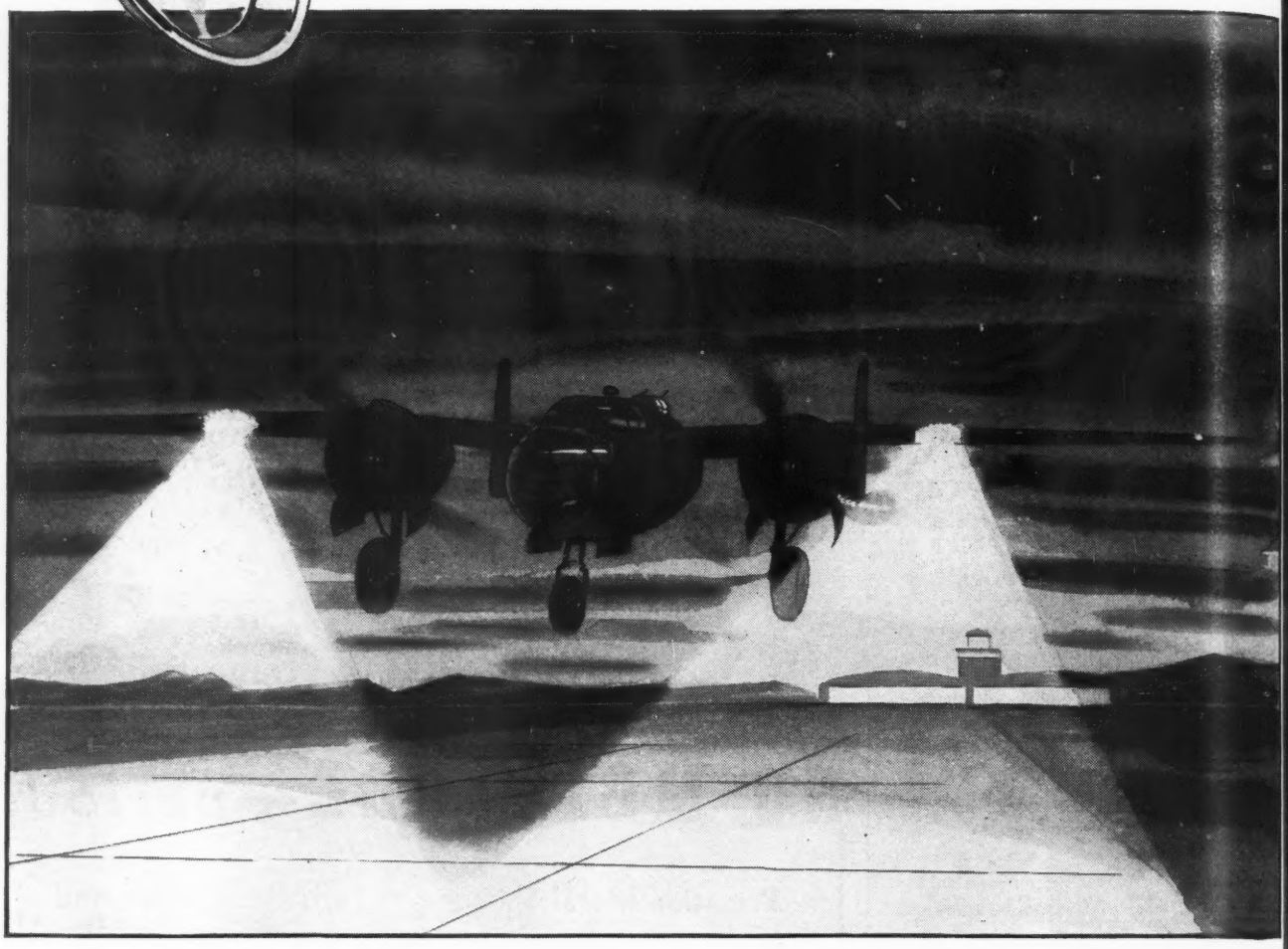
helped airplanes land at night!



THE Army and Navy wanted a new type of airplane landing lamp . . . like the G-E MAZDA "All-Glass" Sealed Beam auto lamps on your car, but with a practically flat lens to fit into the underside of a plane's streamlined wings.

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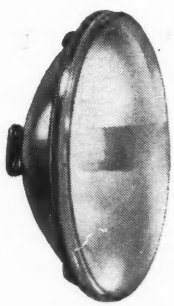

This is the landing lamp that came from a pie plate. General Electric research has developed more than 150 new designs and types of lamps for military uses.

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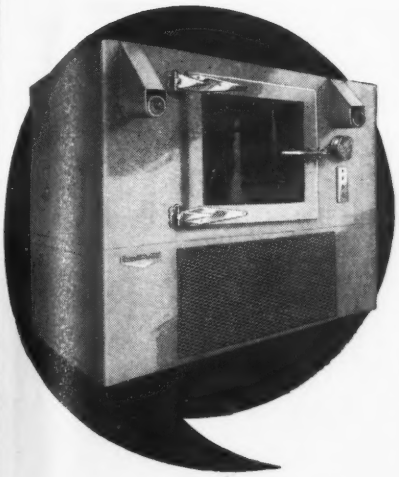

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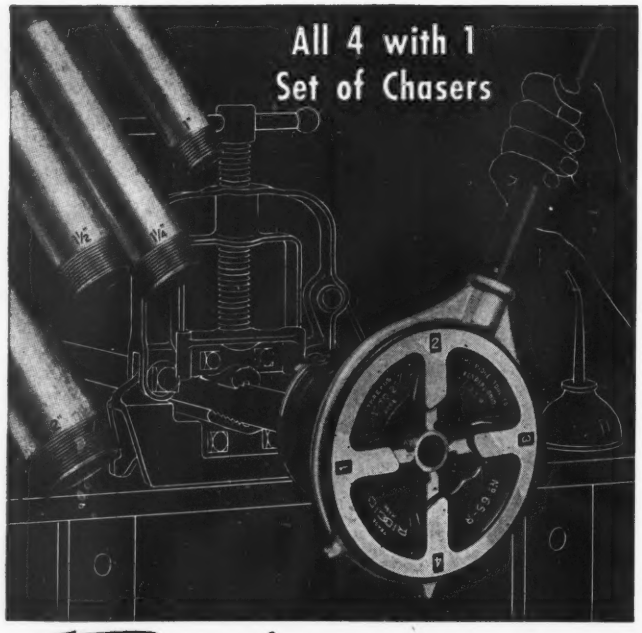

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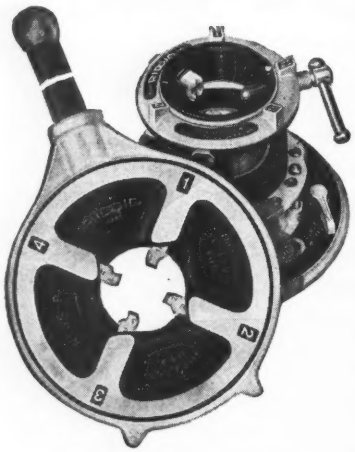

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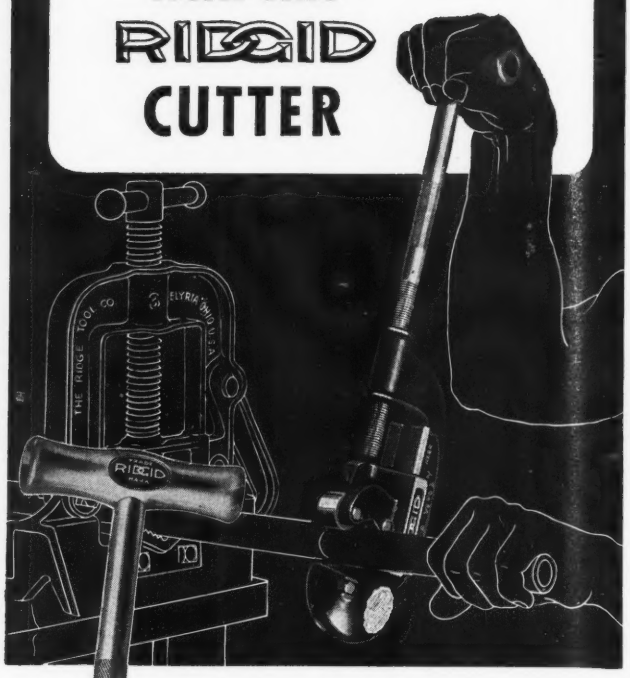

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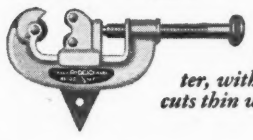

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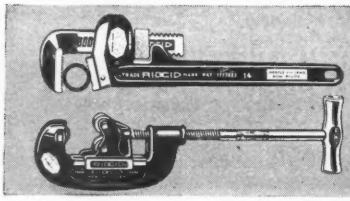

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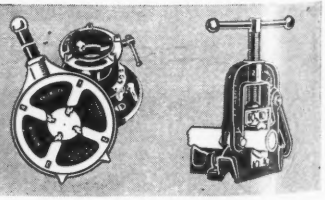
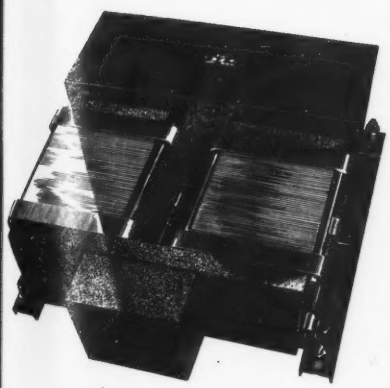


Industry steadies its "nerves"



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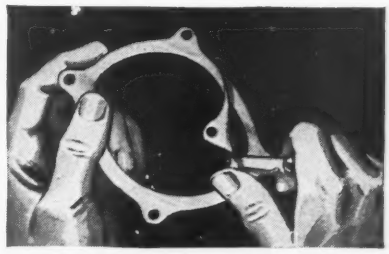

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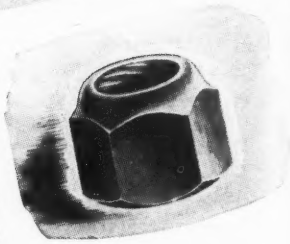

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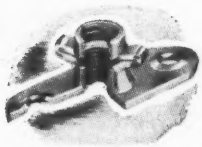
They Fly with their Boots on— a million lbs. lighter!



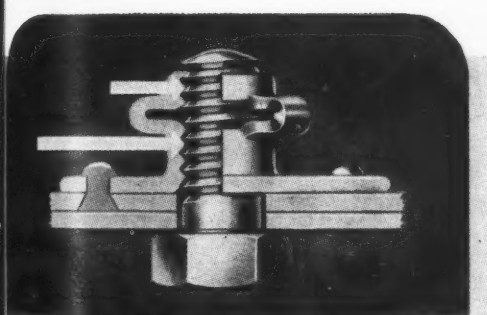
Fighter planes, bombers, cargo planes, trainers, gliders . . . all types of aircraft today "fly with their Boots on." And, because of this fact, they'll fly lighter—*by a million pounds.* For Boots Self-Locking Nuts—the important anchor and channel types—are stamped from sheet metal.

Besides making America's planes a million pounds lighter, they *save* a million pounds in strategic metals.

Government authorized, self-locking nuts . . . all-metal . . . "lighter and everlasting". . . therefore better in operation and maintenance.

Today engine manufacturers are making extensive use of another Boots item—the "Rol-Top," all-metal nut.

All of which means that we have *better* planes, and *lighter* planes . . . with less consumption of metal, when they fly with their Boots on.



HOW IT WORKS

The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction . . . locking threads are out of lead with load carrying threads of lower section.

Upon insertion of bolt, top section of nut is extended to engage with threads of bolt. A constant force is thus established which locks nut firmly into position. Axial thread play is eliminated.

BOOTS

Boots Aircraft Nut Corporation

Self-Locking Nuts for Application in All Industries

GENERAL OFFICES: NEW CANAAN, CONNECTICUT

Corsair TAKEOFF

With a thundering roar the Navy's Corsair fairly leaps off the carrier. Two thousand horsepower is the reason—plus twenty-six years of experience in designing first-line warplanes for America's fighting forces.

CHANCE VOUGHT AIRCRAFT STRATFORD CONNECTICUT

ONE OF THE FOUR DIVISIONS OF THE UNITED AIRCRAFT CORPORATION

The AVIATION NEWS

LAINE STUBBLEFIELD, Washington E. EUGENE MILLER, New York JOHN FOSTER, JR., New York HERB POWELL, New York

Government Committee Plans Formulation Of Postwar Inter-Nation Airline Policies

First step toward international agreement on, and control of, world airlines after the war has been taken. Five government departments have formed a committee to formulate a policy which will guide the role which the United States is to play in the international air system.

Statesmen everywhere believe that aviation will be one of the major instruments of new social, industrial, and trade relations between the countries. There is contention for a revision of prewar policies—when air routes were established between nations on a trading basis ("If you let us go there, you can come here") and when it was customary to require very special permission for the nationals of one country to fly non-scheduled trips over another country.

Two of the main questions are: Shall the United States advocate freedom of world air space, just as oceans are free, for aircraft of all countries to go wherever they choose—or shall we advocate sovereignty and control of the air over each country? Further, if we advocate the latter, on what basis shall we propose to make reciprocal agreements with other countries?

Government departments represented on the committee are War, Navy, State, Commerce, Office of Emergency Management, and of course the White House, with the CAB meanwhile serving on both the main and sub-committee.

The problem is decidedly knotty, involving tariffs and nearly all the phases of international relations. Once the U.S. policy is formulated, negotiations with other countries (possibly through an international air commission) will begin, with a world program the goal.

The United States is now operating nearly all of the world transport mileage and will possess, at the close of the war, a much larger amount of transport equipment than any other country. This obvious advantage on our part already has the British planning their postwar international air interests. Others, including Holland, France, Germany, and Italy, will want to regain their lost routes.

AAF and Airlines Win Collier Trophy for '41

To the Army Air Forces and the airlines of the United States went the Robert Collier Trophy for 1941 in a special ceremony in Washington on Dec. 29. Vice-President Wallace, acting in behalf of the President, presented the celebrated 32-year-old award, which is given annually to symbolize "the greatest achievement in aviation in America" during the foregoing year.

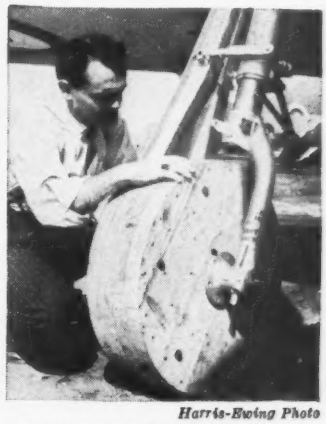
Accepting the trophy for the AAF was Lt. Gen. H. H. Arnold and for the airlines Col. Edgar H. Gorrell, of the Air Transport Assn. *Collier's* Editor William L. Chenery, Maj. Gen. H. E. George of the Air Transport Command, Gill Robb Wilson of the NAA, which makes the annual award, and some 50 other representatives of the Air Forces and airlines witnessed the presentation.

"Recognition is given to the foresight of those in the Army Air Service as well as our private airlines who have done the fundamental planning which has made possible the rapid expansion of the past two years," said the Vice-President in tendering the scroll to Gen. Arnold. "Had it not been for this close cooperation in the 12 months before Pearl Harbor, which laid the foundation for a world-wide air transportation system, it is extremely doubtful that our forces could have achieved the success at arms they have during the first year of the war."

To Col. Gorrell he said: "Our thanks and appreciation to all of your airlines personnel—the tireless executives, the pilots and the devoted mechanics who pioneered in this field and thus were able to furnish that vital 'know-how' which has made world-wide air transportation a living, accepted fact."

The Vice-President also spoke of the "vital and too little known" contribution of the Army ATC and Naval ATS "in flying millions of pounds of strategic cargoes to assure us victory on the home production front as well as on the fighting fronts." And he then forecast that the airports of the world "will be even more essential to the maintenance of a stable peace than Suez, Gibraltar, and the Panama Canal were in the past," with aviation "tying the peoples of the world together."

This was the 26th presentation of the trophy, which went initially (for 1911-12) to Glenn H. Curtiss for his hydro-airplane developments. Since then, the awards have been made annually, except for a three-year cessation during World War I.



Harris-Ewing Photo

PRE-FLIGHT RUBBER SAVER

For portability during pre-flight stage of construction, NAA equips its P-51 "Mustangs" with wooden wheels. Later, when planes are "set to fly," rubber tires are mounted. On wheel above, unidentified humorist has pencilled, "Do Not Inflate."

Press Association Photo

AAF and airlines, "which laid foundation, then built world-wide transportation system which proved salvation for our forces in field," share Collier Trophy for '41. Photo shows presentation by Vice-Pres. Wallace (right) to Col. Gorrell of ATA (left) and Lieut. Gen. Arnold, AAF chief.

Vought-Sikorsky Revision

Reconstitution of Vought-Sikorsky Aircraft — whereby the Chance Vought division will concentrate on the development and production of combat-type aircraft, while the Sikorsky division will carry on development of the helicopter both as a military and commercial project—is announced by the United Aircraft Corp.

Igor I. Sikorsky continues as engineering manager of Sikorsky and Rex B. Beisel meanwhile has been named engineering manager of Vought. For the present, both divisions, operated under the general managership of C. J. McCarthy, jointly will occupy the existing office and plant facilities in Connecticut.

READING TIME: 4 Min. 53 Sec.
SCOTT-CAST "40-E"
ALUMINUM ALLOY CASTINGS
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Job Stabilization Program Is Launched By Los Angeles Area WMC Committee

Jobs of half a million war workers in the Los Angeles area were stabilized, effective Jan. 18, under a far-reaching plan announced by the Southern California Area War Manpower Committee, composed of both management and labor representatives.

Requiring that workers in 30 designated major divisions of essential work may not switch jobs unless they have a "certificate of availability" from the War Manpower Commission, the plan affects such worker classifications as aircraft, aircraft parts, production of metal shapes and forgings, and the several supplementary fields integral to the airplane industry.

Among the management representatives of the committee is W. G. Tuttle, Vultee's director of industrial relations.

The following three basic points of the stabilization program are accented by H. R. Harnish, Southern California WMC director and area committee chairman: 1. An employer shall hire a worker only upon presentation of a WMC "availability certificate" furnished by the job applicant's last employer or an authorized WMC agent. 2. The certificate shall be issued to a worker only when such change of employment is in the best interests of the war effort. 3. Employers shall not discharge or lay off any employee except where such action is necessitated by circumstances beyond the employer's control or when such action is in the best interests of the war effort.

Aimed at full utilization of manpower and womanpower, the plan is expected to restrict undue migration, eliminate excessive turnover of jobholders, and stop "pirating" of workers.

The program's operation will be centered in all local U. S. Employment Service offices. Availability certificates will be issued in quadruplicate, one copy going into the records of the job seeker's last employer (or authorized WMC agent if the applicant has been unemployed), one going to the committee's records, and the other two being given to the worker applicant.

When an employee is hired he surrenders his two copies to his employer, who retains one copy and sends the other to the WMC area office for statistical and control purposes.

An employee desiring to move to a new job may file his plea with his employer and the collective bargaining agent, meanwhile being required to remain at his current work. Should issuance of the certificate be contested, a War Manpower Commission representative will review the case, and the employee, his bargaining agent, the current employer and the prospective employer all have a right to appear at the hearing.

Ruling of the WMC representative may, within three days, be taken by any or all parties to an Area War Manpower Committee appeals committee, which shall be equally composed of labor and management representatives.

DOUBLE ACTION

Foreboding "valentine" for Hitler and Hiro is this first view of double assembly line at Consolidated's Texas plant. In foreground, B-24 "Liberators" are getting combat modifications—yes, they're now "line-groomed" as well as "line-made." And line in background is crammed with C-87 "Liberator Express" transports. Picture shows only a small portion of factory.

WHEN ACCURATE TAXIING IS A MUST...

AERONCA LIAISON PLANES RELY on SCOTT

Maneuvering on roadways and other restricted landing areas calls for extreme skill of the pilot. Contributing to this skill, Scott Steerable Full-Swivel Tail Wheel Assemblies respond with positive action, guiding the Army's efficient Aeronca Liaison Planes to safer take-offs and landings. ★ ★ Built to take the abuse of emergency service, Scott Tail Wheel Assemblies combine exceptional lightness and strength. Each Scott Tail Wheel Assembly is static-tested for shock resistance to guarantee dependable performance under the most exacting ground conditions. ★ ★ Scott Tail Wheel Assemblies are part of an ever-expanding line of special equipment for the air services—equipment which includes oxygen manifolds... oxygen regulators... brake pressure units... control wheels... stabilizer yokes... rudder horns... aileron bell cranks and Scott-Cast "40-E" aluminum alloy castings. Your inquiry on special equipment will receive prompt and confidential attention.

ARMY (E) NAVY

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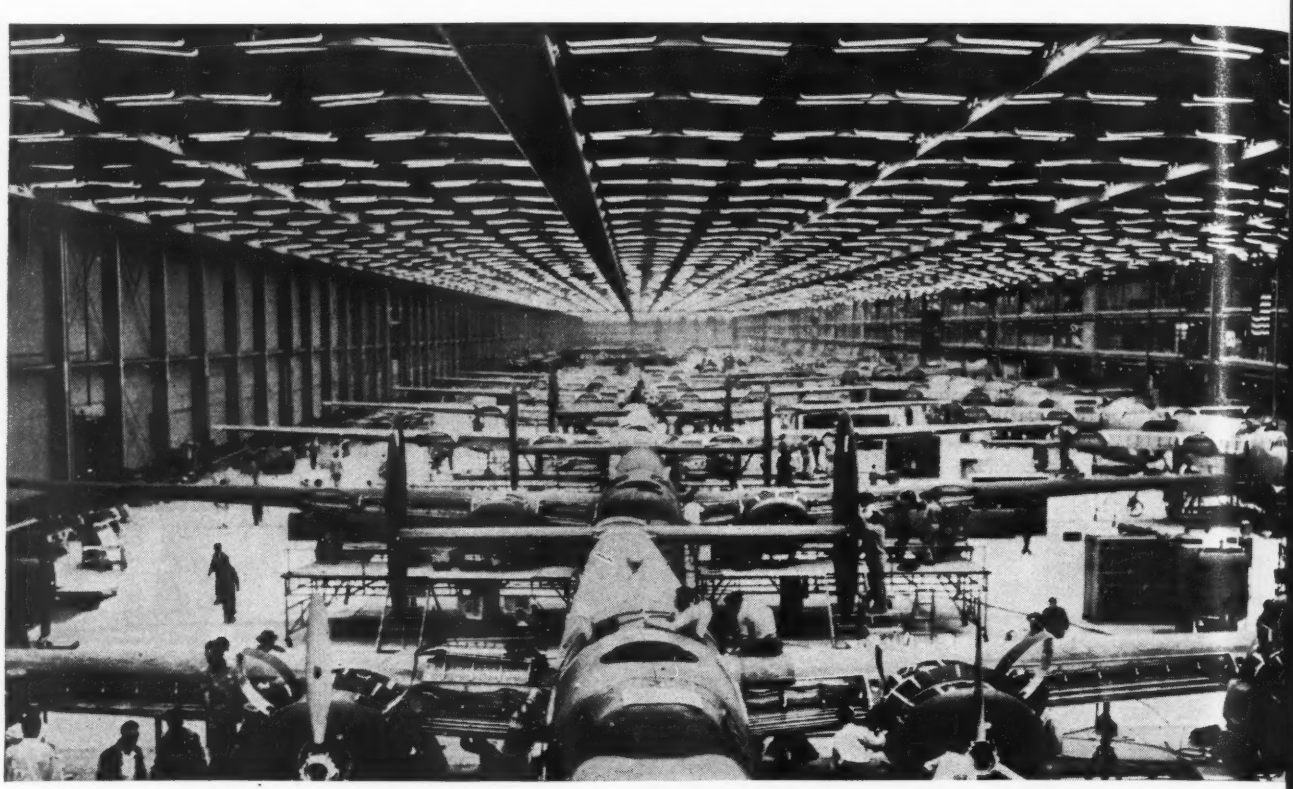
SUPPLIERS TO THE U. S. ARMY AND NAVY AIR FORCES AND LEADING AIRCRAFT MANUFACTURERS

PLANE PRODUCTION SPEEDED BY GIANT LIGHT REFLECTOR



White cement floor reflects 61% more light on the under side of bomber wings and fuselages...20% more light on vertical working surfaces. This type of floor used in Boeing, Consolidated, Douglas and North American plants.

LIGHT-REFLECTING FLOORS, made with Atlas White Cement, are acting today as giant reflectors and diffusers of light in essential war plants. They chase shadows from production and assembly lines. According to tests by General Electric in Consolidated Aircraft plant, this type of floor reflects 61% more light on under-side surfaces of planes than does the gray concrete floor in the same plant. These tests also showed that the white cement floor produces 20% more illumination on vertical work surfaces than does the gray cement floor.

By providing this increased illumination, light-reflecting floors help employees operate with greater speed and safety . . . reduce errors and spoilage of materials. They sharpen the vision of workers who have defective sight . . . of older men and of new workers who are working at a machine for the first time.

White cement floors in aircraft plants for Boeing, Consolidated, Douglas and North American are showing their superiority over darker floors. In installations already made they have repaid their initial cost quickly. They can be cleaned and kept white simply and economically.

Write for a new book, "LIGHT FROM FLOORS." It tells about the advantages of better illumination and gives detailed information on the construction, maintenance and value of light-reflecting floors made with Atlas White cement. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

• • •

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ATLAS WHITE CEMENT

FOR LIGHT-REFLECTING FLOORS

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Please send me copy of new book, "Light from Floors." AV-F

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Aircraft Tailor Shops" efit Planes for Action

Dubbing them "aircraft tail-ring shops," the OWI has ow released a short news ory on the little publicized odification centers where andard mass-produced war-lanes are altered to meet the arying combat requirements n the far-flung fronts.

Revealing to the public that here are a chain of these cen-ers operated by airlines and ircraft factories under super-ision of the AAF Material ommand's Production Di-ision or directed by the Air orces at air depots, the item ells how the planes—often avy as well as Army—are erviced with the pertinent amouflage shades, added fly-g range, increased bomb ca-acity, etc., specifically called r by the Arctic, desert, or ungle operation planned.

Mention is made of refitting Martin *Marauder* bombers as orpedo planes, equipping Maj. en. Doolittle's Japan-raiding orth American *Mitchells*, and rooming the Consolidated *iberators* which last spring lasted the Rumanian oil ields.

lt 22 Airport Jobs

Construction on 22 airport rojects in 13 states has been alted or curtailed by the PB to conserve war mate-ials. All CAA-sponsored, 16 alled for field developments nvolving a $13,851,817 total xpenditure, while the other ix involved new lighting fa-cilities to cost about $300,000. Airport work, billed at from $394,000 to $2,880,000, was stopped immediately at No-gales and Willcox, Ariz.; Mi-ami, Fla.; Mason City, Iowa; Donaldsonville and Ruston, La.; Natchez, Miss.; Helena, Mont.; Saranac Lake, N. Y.; Cushing, Okla.; Wilkes-Barre, Pa.; Georgetown, Tex.; Mont-pelier, Ida.; Devil's Lake, N. D.; and Santa Fe and Artesia, N. M.

New Army Pilot Training To Utilize CAA Facilities

Expansion of its program for combat-and-service pilot training is now announced by the AAF, which plans to use some 100 colleges throughout the country as training centers, choosing the institutions according to their convenience to airfields. The courses are to begin in April.

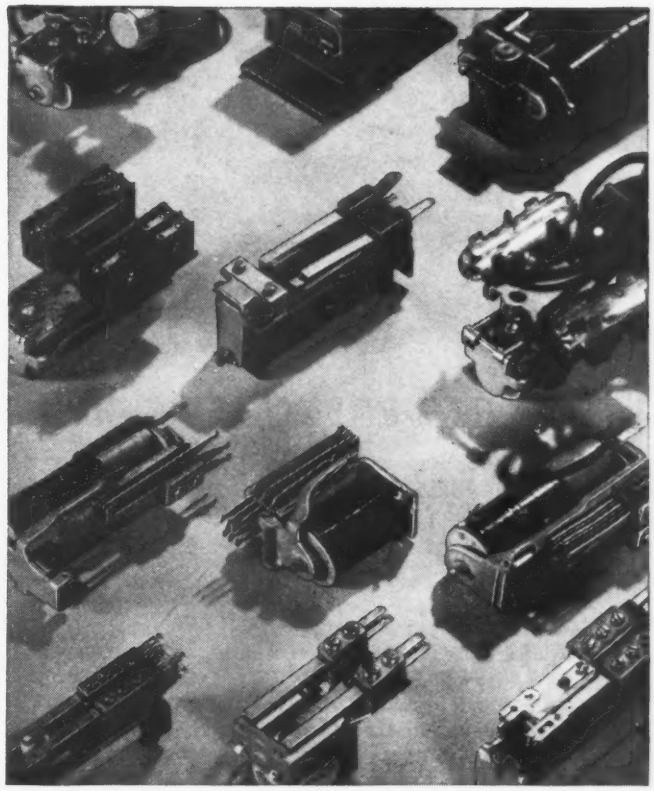
In this move, it is stated that maximum use of existing CAA facilities will be effected through Army-CAA cooperation. Meantime, the new designation CAA WTS (War Training Service) replaces the CPT identification formerly employed.

There will, it is understood, be two divisions in the new set-up: First, transport or instruction-work training for men deemed not suited for combat flying; second, special qualification courses for prospective cadets prior to their entrance into regular AAF schools. The number of men to receive the latter training will depend on facilities avail-

International News Photo

UNITED TESTS ITS CO-AXIAL PROPELLER

Dual-rotating constant-speed airscrew, product of United Aircraft's Hamilton Standard Propeller Division, is here seen mounted on plane at Rentschler Field, where first test hop was made. Twin three-blader employs co-axial shafts.



CAN RELAYS SOLVE YOUR *Electrical Control* PROBLEMS?

IF SO, which type? How will it be used? What combination of coils and contacts will be needed? These and similar questions on electrical control are facing makers of war products every day. There's an easy, sure way of getting the right answer—

You can obtain skilled aid in selecting the right relay, stepping switch or other control part for your product by calling in an Automatic Electric field engineer. He can place at your disposal the technique gained through a half-century of experience in the design and application of control devices. He can help you save design time, reduce your costs, insure reliability of your product.

Helpful, too, is our new 80-page catalog —a storehouse of useful data on electrical control apparatus and its uses. Write us for your copy, or telephone our nearest office.

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
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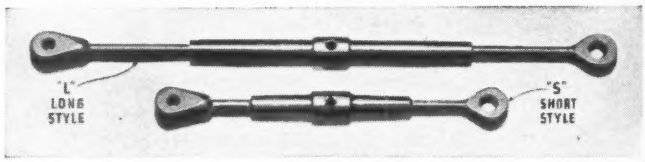
Relays AND OTHER CONTROL DEVICES *by* AUTOMATIC ELECTRIC

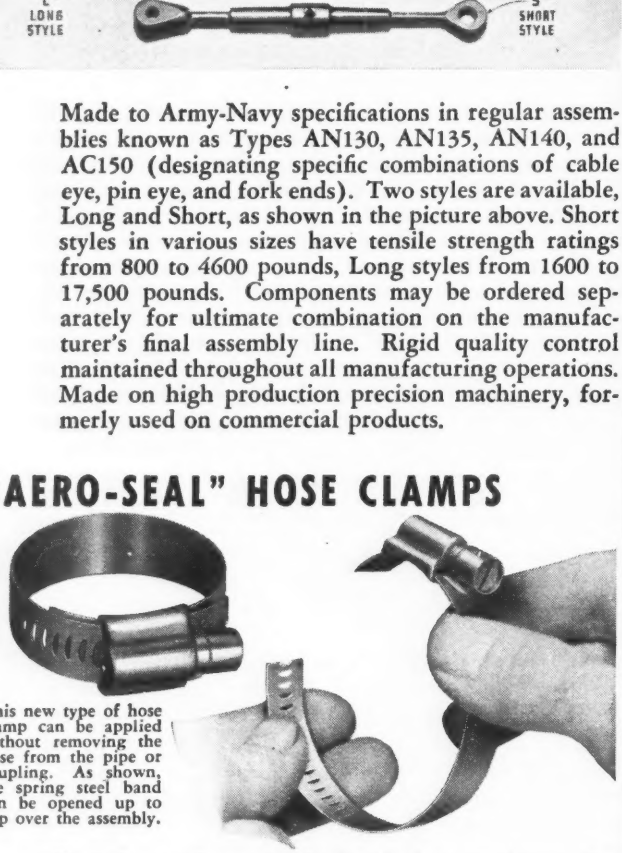
SEE AIRCRAFT Standard PARTS CO. FOR...

AIRCRAFT TURNBUCKLES



Made to Army-Navy specifications in regular assemblies known as Types AN130, AN135, AN140, and AC150 (designating specific combinations of cable eye, pin eye, and fork ends). Two styles are available, Long and Short, as shown in the picture above. Short styles in various sizes have tensile strength ratings from 800 to 4600 pounds, Long styles from 1600 to 17,500 pounds. Components may be ordered separately for ultimate combination on the manufacturer's final assembly line. Rigid quality control maintained throughout all manufacturing operations. Made on high production precision machinery, formerly used on commercial products.

"AERO-SEAL" HOSE CLAMPS



This new type of hose clamp can be applied without removing the hose from the pipe or coupling. As shown, the spring steel band can be opened up to slip over the assembly.

Extra-long take-up in the band gives maximum size coverage with a minimum number of clamp sizes. Uniform squeeze is obtained by a belt-like tightening action. Easy operation, with worm and worm gear action. Slotted head on screw has rim to prevent screwdriver from slipping. Design extremely compact. For hoses 1" diameter and larger. Quality construction throughout.

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Circulars on Aircraft Standard Parts products will be sent promptly on request, giving full engineering data and prices. Our products are backed by fifteen years' experience in this field.

1711 Nineteenth Ave.
Rockford, Illinois

AIRCRAFT STANDARD PARTS CO.

able. Many such men are reported now in the Army enlisted reserve awaiting call. In this precourse they will be given up to 10 hr. of flying training by CAA instructors.

Test Hop "Caravan" And "Constellation"

Curtiss-Wright's C-76 *Caravan* plastic-bonded plywood cargo plane has now been test flown several times at the company's Midwest plant. Meanwhile, the *Constellation,* new Lockhead 4-engined transport, has also been put through its initial paces in the air.

Especially short takeoff and fast climb, facilitating operations out of small fields, are reported features of the *Caravan.* Other than in undercarriage and engines, there is very little metal in the craft. Some parts are of plywood, three- to nine-ply, some are of straight lumber, and major tail sections are molded.

The Army has ordered 1,200 C-76's from Higgins Aircraft (Jan. AVIATION, page 279). Curtiss-Wright will cooperate with the latter firm on this strictly Army-Higgins contract.

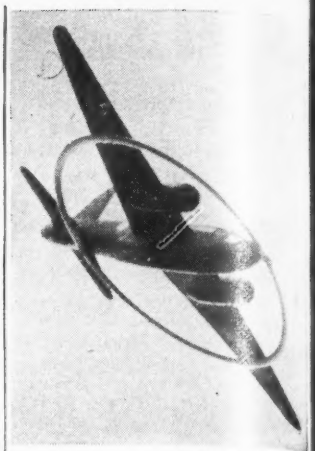
The Lockheed *Constellation* mounts four 2,000 hp. *Cyclone 18* powerplants, cruises at 20,000 ft., and is capable of rising to 35,000. Designed to be a TWA passenger airliner, the initial model and its successors will go to the Army for the duration. (For photos and technical data on these newly tested planes, see this issue's directory section and specification tables.)

Army Buys 3 Helicopters

Washington (AVIATION Bureau)—That it has purchased three helicopters—two Sikorsky SV-300's and one Platt-LePage—has now been revealed to AVIATION by the Army. The craft are under experimentation looking toward possible military use, thus tokening the considerable speculation among aviation people re possibilities of helicopter adaptations in war.

New Modification Center

With the "starting through" of Consolidated B-24 bombers, the new large modification center in Alabama began activity in late January. Permanent structures at the center are scheduled for completion in June, and personnel is to reach some 17,000. Designer, builder, and operator of the base is the Bechtel-McCone-Parsons Corp., already noted for engineering and construction of a 14-way shipyard for the California Shipbuilding Corp.



British Combine Photo

MINESWEEPER OF AIR

"Wellington" fitted with unique magnetic-coil hoop is British aero answer to Nazi magnetic mines. Current, set up in hoop by Ford V-8 auxiliary engine, explodes mines when plane passes. But job is hazardous for mine-sweeping skymen because sudden blasts severely jolt their aircraft.

Mail Rate Petitions Denied

Petitions of the Postmaster General seeking reconsideration of the CAB's opinions and orders in the American, Eastern, Latin-American, and Panagra mail rate cases have been denied by the board.

Asked was the fixing of mail rates which would result in a refund by the air carriers to the Post Office Department of mail compensation already paid. It was contended that the board's duty was to fix rates during pendancy of the proceeding, which would have called for refunds in the cases challenged. Further, the PMG held that the board's new 0.3-mill per lb.-mi. rate granted in the Eastern and American cases was too high.

CAC Opens Parts Plant

Consolidated Aircraft Corp. reports that the new $14,000,000 parts building, added by its Texas division to furnish components for B-24 *Liberator* and C-87 *Liberator Express* planes, is now in production. The new plant was necessitated by production demands, which were further augmented when, last April, the division turned out its first plane 100 days ahead of schedule. Parts formerly supplied by the company's California factory will now be produced "next door" to the assembly lines. The new plant will be operated 24 hr. a day.

Lt. Col. Sherman B. Altick

Word is received of the death, following an illness of several months, of Lt. Col. Sherman B. Altick, AAF, who

or 13 years was aviation editor of the New York *Sun*. In '38 and '40, he was winner of the TWA trophy for newspaper aviation writing, and in '41 he took second honors. In World War I, he joined the French aviation service, later was test pilot with the American forces, and on his return commander of the 15th Squadron at Mitchel Field. Most recently, he was aide to Gen. Doolittle before the latter went overseas.

Miami Caribbean Service Being Held Up by Navy

Washington (AVIATION Bureau) — Proposed certification by the CAB of about seven airlines to cover the Caribbean region from Miami has been held up by the Navy. Some months ago, CAB invited bidders on these routes, without specifically setting forth the routes. In order to qualify, bidders had to have equipment not otherwise effectively participating in the war effort. Seven were found eligible, and apparently they were about to be certified.

Records indicate the board itself initiated the call for bids. However, qualified persons say the request actually was originated by either the Army or the Navy in a move to expedite transport of strategic supplies to Caribbean points and help remedy the shortage of surface shipping.

Whether easing up of the Axis threat through French possessions, decline of the submarine menace, or some Army-Navy clash over jurisdiction curbed certification of the new services could not be learned. Word has circulated in the CAB that the Navy had suggested taking over any Caribbean operations under its own Air Transport Service. The situation is further complicated by the fact that a British line is included in the picture.

Women in Air Training

Request has been made for the services of WAAC's to replace enlisted AAF men now needed for combat duty. More than 25 technical jobs will be taught the women, with 'chute rigging, bombsight repairing, weather observing, and glider instruction newly added. . . . Women pilots have now gathered in Texas to train for ATC ferry duty. "Jackie" Cochran heads the school. . . . Curtiss-Wright will pay for the training of 800 college women at eight engineering schools. Later, they will get positions in either the airframe or propeller divisions. . . . The Navy will open five schools to train enlistees of the Women's Reserves to become aviation machinists' mates, metal smiths, Link trainer instructors, aerographers' mates, and 'chute riggers. . . . In Tennessee, ten women pilots have become instructors guided by Phoebe Omlie.

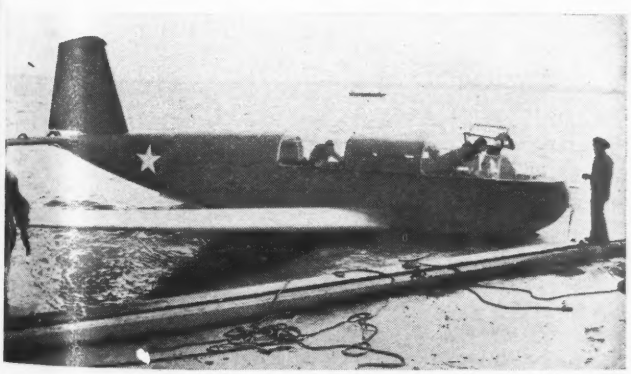
C. E. Firm Anniversary

Completion of ith 45th year was celebrated recently by the Chambersburg Engineering Co., Chambersburg, Pa. Founded by W. H. Derbyshire, the company is maker of drop hammers, presses, and the Cecostamp, special impact stamping machine for the aviation industry. First hammer order was received by the company in 1898. "And that hammer," states Pres. E. C. Clarke, "is still operating."

Produce Wickwire Props

Production of the new Wickwire variable pitch, fully automatic, special-wood propeller is announced by Pres. E. C. Bowers, Wickwire Spencer Steel Co. While the airscrews will currently be made for war purposes only, a wide postwar

(*Turn to page* 396)

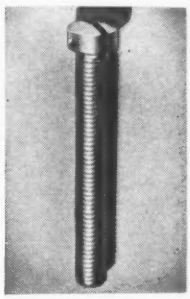


Press Association Photo

GLIDER FOR MARITIME MISSIONS

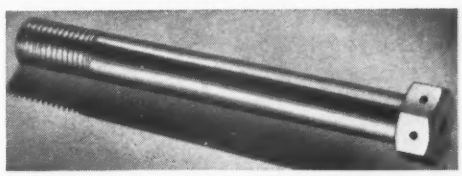
Our Navy's newest sky weapon, the Bristol XLQ-1 amphibian glider, was recently put through paces. Towed aloft by PBY "Catalina," wood craft circled twice after release was tripped, then landed on river. It is 40-ft. long, has 72-ft. span, and will carry twelve men.

DRILLED FILLISTER HEAD MACHINE SCREWS



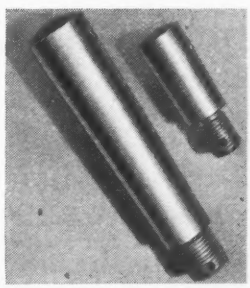
Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross-drilling is desirable, nickel steel screws conform to Navy drawing NAF-1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

STEEL DRILLED HEAD AIRCRAFT BOLTS



Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.

THREADED TAPER PINS



Specially-designed pins, generally used in aircraft construction in place of commercial taper pins. Made to conform with Air Force drawing AC386 in sizes from 1 through 5. Can be furnished with threaded end either drilled or not drilled for cotter pin. Material is nickel steel of Army-Navy AN-QQ-S-629 specification, cadmium plated in accordance with AN-QQ-P-421. Centerless ground after hardening to insure accuracy and uniformity. Companion AN975 washers also available.

CATALOG AND ENGINEERING DATA

Send for your copy of new Catalog No. 101, showing complete prices and engineering data on Hexagon and Drilled Head Bolts, Clevis Bolts and Pins, Fillister and Washer Head Screws, and Threaded Taper Pins.

AERO SCREW COMPANY
19th Ave. at 12th St., Rockford, Illinois

DIVIDE BY 6 AND A

35,000

TAKE the industrial generator shown here (in blue). Divide its weight—280 pounds—by six. Then give it special insulation and other features to permit its operation at 35,000 feet altitude or more. The result is the G-E aircraft generator—light, compact, high-altitude conditioned.

The two generators shown have the same capacity. The larger one is a standard type widely used in industry. The smaller is the aircraft generator used on most of our military planes today. It is built by General Electric, and by others to G-E designs.

This generator is an example of how electricity, and electrical engineering skill, are helping aircraft designers to increase power and to control weight. Before Pearl Harbor, an aircraft generator then considered light weighed 30 pounds, and had a relatively small capacity. Today, with power demands for individual planes greatly increased, the capacity of the generator has risen substantially, yet weight has increased only a few pounds. This represents a considerable advantage to designers of our military planes.

As ships increase in complexity, the need for automatic operation becomes more pressing—to free air-crew members for more important duties. The resources of General Electric are devoted to the manufacture of such automatic systems. Systems that automatically position cowl flaps and intercooler shutters, synchronize the operation of two or more parts of the ship, control armament—take over flight operations formerly performed by the ship's crew. The flexibility, reliability, and light weight of electric control and operating systems are reasons why many designers now make it electric when they make it automatic. *General Electric, Schenectady, New York.*

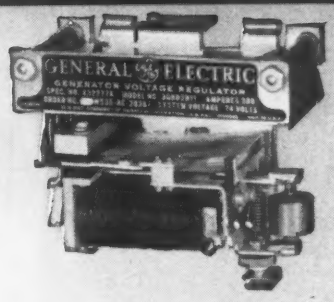
Aircraft electric systems designed and manufactured by General Electric make possible the automatic control of many different flight operations. The degree of secrecy required is so great that we cannot publish information about these integrated systems now. We are glad, however, to discuss the application of automatic electric systems to aircraft with design and production engineers.

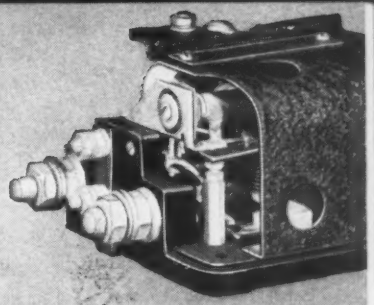
GENERAL ELECTRIC

674-3-8290

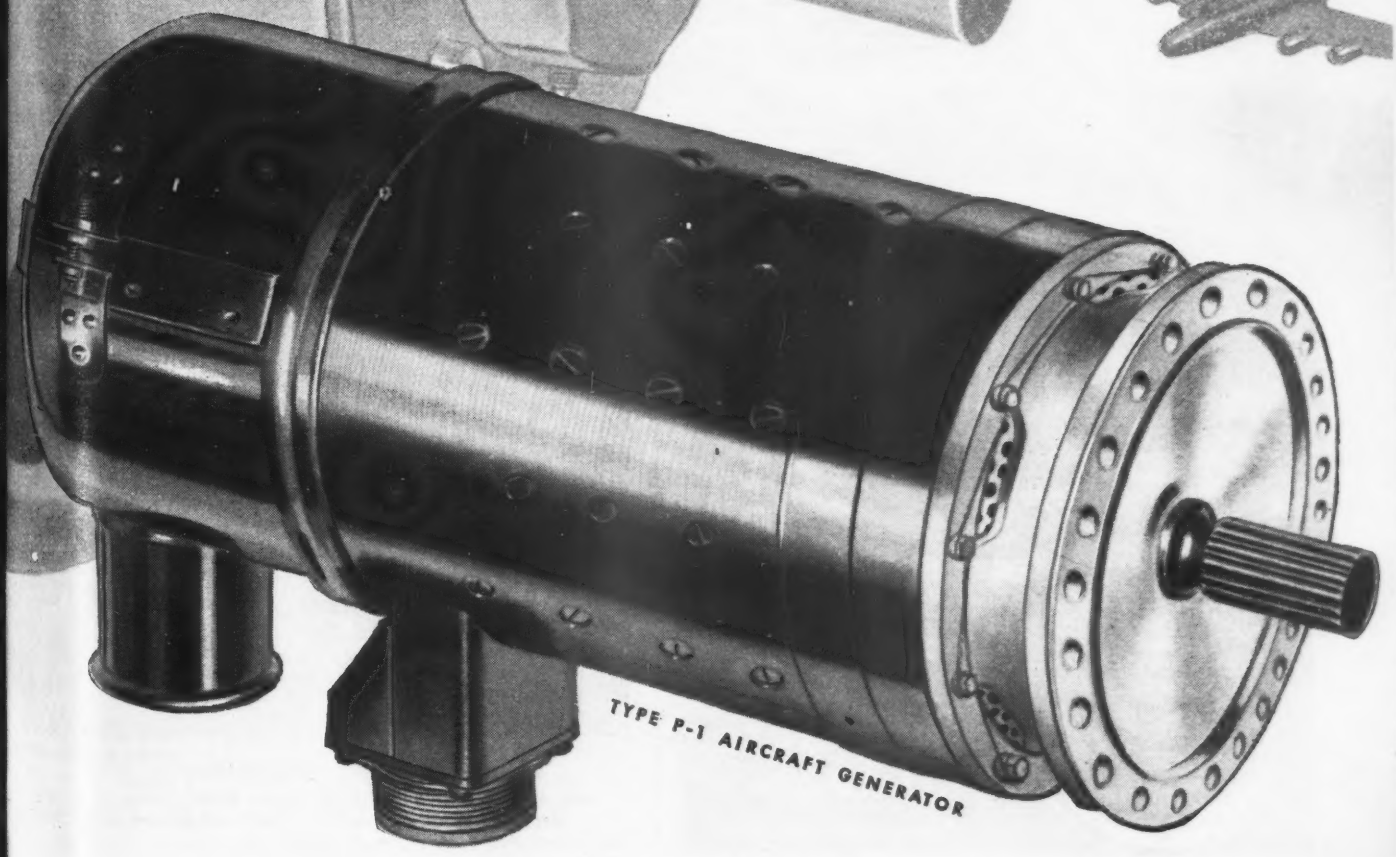
ADD

feet



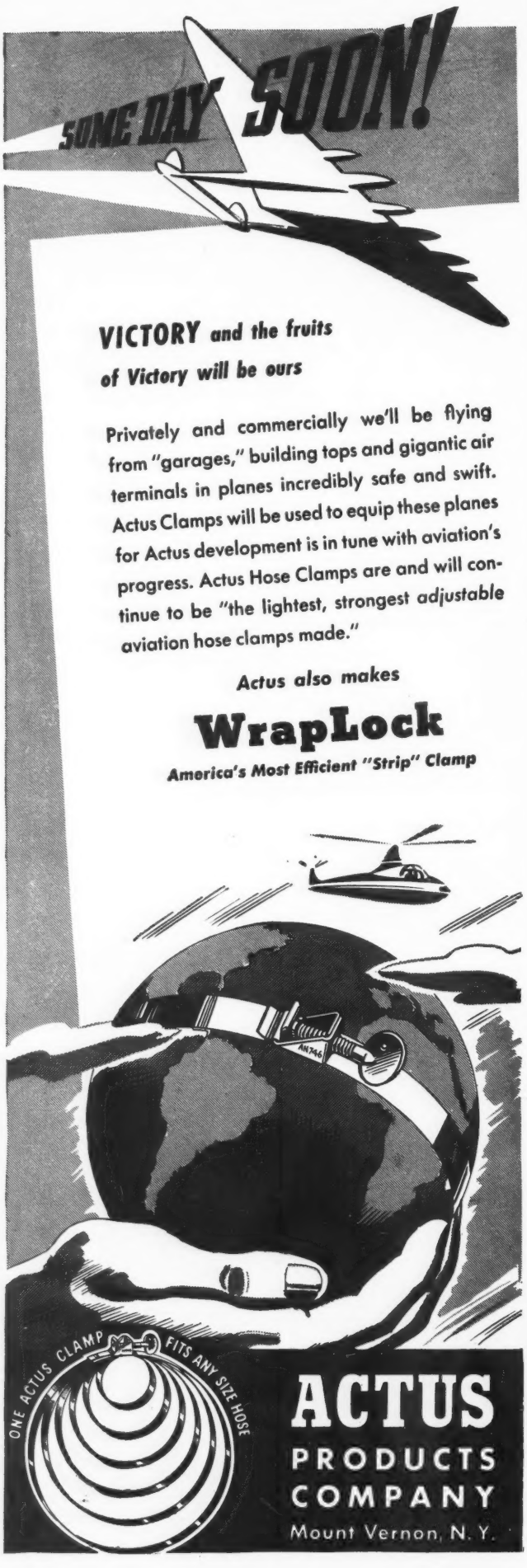


G-E voltage regulators, to maintain correct voltage, and relays to control generator current flow complete the electric generating system. Each of the three units is designed to function with the others as part of a co-ordinated system.



TYPE P-1 AIRCRAFT GENERATOR

The Army-Navy "E", for Excellence in the manufacture of war equipment, now flies over six G-E plants employing 100,000 men and women.


SOME DAY SOON!
VICTORY and the fruits of Victory will be ours
Privately and commercially we'll be flying from "garages," building tops and gigantic air terminals in planes incredibly safe and swift. Actus Clamps will be used to equip these planes for Actus development is in tune with aviation's progress. Actus Hose Clamps are and will continue to be "the lightest, strongest adjustable aviation hose clamps made."
Actus also makes
WrapLock
America's Most Efficient "Strip" Clamp
ONE ACTUS CLAMP FITS ANY SIZE HOSE
ACTUS
PRODUCTS
COMPANY
Mount Vernon, N. Y.

civil-flying use of them is foreseen by the company, which points to their applicability to the family-type plane.

Air Priority Granted For Emergency Imports

WPB has announced development of a special air cargo priority certificate to fit into the world-wide service for the import of strategic cargoes. Loadings in question, under control of the Army and Navy transport commands, are arranged by the Board of Economic Warfare through government procurement agencies.

A system of WPB priorities and quotas covering all strategic goods suitable for air transport has existed since last April. To this is now added the special certificates covering emergency shipments. Private importers and government agencies likely to require air transportation for their purchases abroad can make application to WPB for the certificates.

The new arrangement will make maximum use of the routes, to the end that planes carrying combat units outbound may subsequently return with materials which otherwise would be difficult to import. The priorities list assures use of such available space for the most vital cargoes.

Flight Strips See Action

That flight strips, more than a score of which have been completed or are under construction, have already figured in some 15 emergency landings is revealed by Thomas H. MacDonald, Commissioner of Public Roads, Federal Works Agency.

He specifically cites instances in which the "bargain counter airports" saved two storm-hemmed planes, loss of either of which "would have cost the government almost as much as the flight strips involved, to say nothing of the priceless trained men." (For details of these roadside runways, see article, Flight Strip "Hows" and "Whys," Jan. AVIATION.)

★★ IN BRIEF ★★

Despite the 40 percent war reduction in its fleet of airliners, improved efficiency has enabled UAL to fly 520 more miles per plane per day. The company states it is averaging but one mechanical delay for every 23,000 mi. of flying. . . . Officials now say that the Navy, too, plans to use Consolidated *Liberator* bombers. . . . PAA has broken ground for a million dollar hangar building in Florida. Simultaneous servicing of 12 to 18 planes, depending on their size, will be permitted in the new structure. . . . Not only trainers, but fighters (*Mustangs*) and bombers as well are now being built by North American Aviation's Texas plant.

Sixteen Piper Aircraft Corp. pilots speedily had more than 100 Army L-4 and Navy HE-1 craft airborne when, on Dec. 30, the flood-swollen Susquehanna River threatened to make them all waterborne. In zero-zero weather, the flyers hopped menaced ships out of

International News Photo

QUICK-EXIT "DRAWBRIDGE"

To speed battle landings of airborne troops, British Horsa glider features "drawbridge" type fuselage panel. Here, "down and at 'em" soldiers practice split-second starts from the big engine-less transport.

Cub-Haven Airport and over to higher ground, then hurried back by auto for more until the job was done. . . . Proposal by Dr. Sanford A. Moss, General Electric expert, is that integral powerplants be developed which are readily interchangeable between American and British warplane fuselages. He envisions the devising of internationally-standard units—comprising front section of nacelle, engine, turbo-supercharger, generator, propeller, and accessories—for attachment to standardized nacelle fire walls of either country's planes.

American Propeller Corp., Aviation Corp. subsidiary, has purchased additional machinery and equipment increasing its present plant capacity by 50 percent. Its hollow-steel airscrews are used on AAF bombers. . . . Mexico City reports arrival of a number of U.S.-built patrol planes for coast defense duties. Further, the Mexican Navy is said to be negotiating for U.S. torpedo planes. . . . Though thousands of "green" workers have been added by aircraft factories, a recent Aero Chamber survey indicates that, over all, the odds against an employee having an accident on the job is only about 300 to 1. This means the 1939 rate of 15.3 per 100,000 man hours—which wasn't considered excessive—has been bettered by more than 50 percent.

Substantial savings to the government in airplane costs will be realized, states the OWI, as a result of a reduction of 2c per pound in the base price of virgin magnesium, and other new reductions by the Dow Chemical Co., pioneer and largest producer of magnesium. High war volumes made the new economies possibles. . . Chrysler reveals that its new Dodge Chicago plant, hailed as the world's largest manufacturing unit, will consist of 15 buildings, one of them big enough to cover 50 city blocks. It is scheduled to make aircraft engines. . . . Consolidated has perfected a device known as the Bal-O-Dial to aid pilots in computing the loading balance of their planes. All such factors as the weight of the airmen, gasoline, oil, bombs, and ammunition are considered by the gadget, which supplies the calculations in a minute or two without need for higher mathematics.

New British Transport

Britain has a new transport plane model — the *York* — in production. While it is understood that the plane is large, its details and maker's name have not been given.

Aviation Finance

By RAYMOND HOADLEY

TO MEET the government's program calling for double warplane production this year, the aircraft manufacturing concerns, taken on the average, obviously will establish vastly larger delivery records in 1943, and meanwhile there will be considerable more aid from the automotive industry, now highly augmenting its contribution which was but 25 percent of the total aircraft output last year.

Bendix Aviation Corp., for example, whose sales skyrocketed to approximately $460,000,000 in 1942 from $156,000,000 in 1941, anticipates deliveries valued at better than $900,000,000 this year. Despite the prospective increase in sales, however, earnings for the aircraft makers this year probably will not run very much higher than the net income shown in 1942 because of war taxes and the ever-present renegotiation-of-contract situation.

Thus the mere announcement of stepped-up operations and increased orders has long since failed to cause the stock market flurries in aircraft shares which were so frequent before the war.

Airline stockholders, on the other hand, face a year which may bring considerable change in the present status of their holdings. The present trend of increasing revenues and declining costs is likely to level off shortly, for there appears little possibility of the lines receiving more equipment for their regular domestic routes. Then, too, all coming CAB decisions will be watched with interest, since the hint already has been given out that this regulatory body believes the airlines have reached the point where they can operate without government airmail subsidy. At the same time, agitation has started for lower passenger rates.

Increased airline earning power this year may depend largely on how profitable the industry's war transport contracts with the government turn out. Fundamentally, it is all a matter of whether Washington is going to allow the airlines currently to accumulate a little "fat" in preparation for the tremendous postwar job that awaits them.

Square D Co. has completed arrangements with the National Bank of Detroit and participating banks for a regulation V loan of $10,000,000 to provide additional working capital required for the financing of war production contracts. Northeast Airlines, Inc., also, has negotiated a V loan for $1,500,000 from Boston banks to finance expansion of facilities placed at the disposal of the United States Army.

Aviation Capital, Inc., has applied to the SEC for an order declaring that it has ceased to be an investment company within the meaning of the investment company act of 1940.

Beech Aircraft Corp. sales in the fiscal year ended Sept. 30, 1942, totaled $59,592,953, more than seven times the $8,062,204 deliveries reported in the previous year while net profits amounted to $2,417,819 or $6.04 a share compared with $471,715 or $1.17 a share in 1941. While a refund of $7,200,000 to the government was deducted from 1942 operations, the War Department has proposed a downward adjustment of net income that would amount to $2,715,375, before federal and state taxes. The company rejected the proposal, but the year's earnings are subject to any renegotiation agreement the company and the government may agree upon.

Pan American Airways Corp. is reorganizing its Brazilian subsidiary, Panair do Brazil, with a capital increase to $1,500,000. The reorganization will offer Brazilian capital a large participation in future earnings.

Vultee Aircraft, Inc., after acquiring 6,320 shares of its cumulative preferred stock last year, retired all holdings before the year-end.

North American Aviation has increased its contract with Defense Plant Corp. to provide additional plant facilities in Texas at a cost in excess of $1,250,000, resulting in an over-all commitment with DPC of more than $34,000,000.

Transcontinental & Western Air, Inc., has reported net profit of $1,531,665 or $1.61 a share for the nine months ended Sept. 30, 1942, as against a net loss of $49,204 in the like 1941 period. Only a small fraction of these earnings resulted from fees under war contracts.

T. E. Braniff, president of Braniff Airways, Inc., stated in a recent report to shareholders that "current prospects for increased volume of business are decidedly favorable. The opportunity which has been afforded us to participate actively in the war effort is one which has been greatly appreciated and it has added to the morale of the whole organization."

Studebaker sales of war goods in 1942, including aircooled aircraft engines, totaled $215,000,000, and they should mount to approximately $350,000,000 in 1943 since production reached its peak last mid-year. Another automotive company, Packard, which makes British Rolls Royce engines, estimates 1943 sales volume at $300,000,000 as compared with $206,000,000 in 1942.

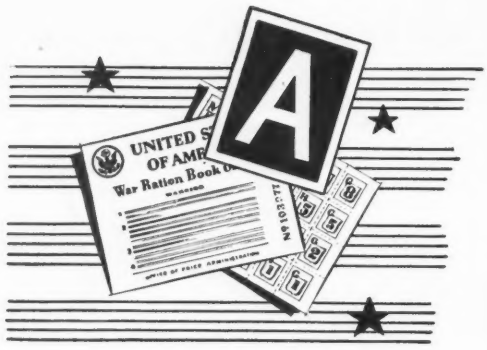
Waco Aircraft Co. reported net earnings of $133,759 or 92c. a share for the fiscal year ended Sept. 30, 1942, as compared with $192,107 or $1.32 a share in the 1941 year.

Solar Aircraft issued a semi-annual report for the six months ended Oct. 31, 1942, showing sales of $8,261,317 compared to $8,553,300 for the full fiscal year ended April 30, 1942. Net income for the six months was $1,517,843 compared with $685,384 for all of the preceding year. Sufficient business is on the books, according to Edmund T. Price, president, to keep all plants at capacity operations for the greater part of 1943.

United Air Lines and two subsidiaries have been awarded $364,423 as compensation for services owed by the government prior to cancellation of the air mail contracts in 1934, but the Court of Claims rejected the line's suit for $2,477,774 damages growing out of the contract annulment. It is expected the case will be carried to the Supreme Court.

Republic Aircraft Corp. and Maj. A. P. de Seversky have "amicably settled and adjusted" their troubles out of court, according to Ralph S. Damon, president of the company. The major had filed suit in 1940 for $2,497,069 for services rendered and has had a $20,000,000 stockholders suit pending for several years.

Aircraft Accessories Corp. began payment of a dividend of 15c per common stock share on Dec. 18. Dividend was voted by board of directors on Nov. 27.



Star-Spangled RATIONING

In wartime we expect our fighters to have better guns for knocking off Nazis than we keep around home for knocking off squirrels.

In wartime we are glad to use our cars a lot less so the boys in Africa and Australia can use their tanks and planes a lot more.

In wartime we are proud to turn over our factories to build products that fight, instead of the things of peace.

In wartime we are happy to buy bonds that help carry something more than moral support around Murmansk way.

But how far personally are we really willing to go to help win the war?

There are men who hid hundreds of gallons of gasoline in their basements before rationing.

There are women who tucked their closets full of sugar before the lid went on.

There are people who wore themselves footsore buying up coffee before it was restricted.

These folks perhaps have no sons in the Solomons, or husbands, brothers or relatives in Africa.

They perhaps feel only the cold wind on their necks when they uncover for the Star-Spangled Banner.

They for sure are in the minority—there just can't possibly be more than one American worm to every thousand American patriots. As makers for years of essential parts for automobiles and airplanes as well as products for home and farm, we believe the way Americans are wearing their "A" cards indicates the spirit with which they will meet all other forms of wartime sharing and rationing.

We believe the true American breadwinners and housewives and their thinking children—and there are 130 million of them—see the advantage of all Americans at home sharing alike—see the need of first providing adequate food and supplies for fighting forces and fighting allies.

★ ★ ★

We believe if there isn't as much food or gasoline or clothes to permit everyone to have as much as he wants, the supplies that are available should be divided as equally as possible so that all may have a fair share.

We believe rationing should be maintained only as long as these wartime needs are present.

We believe rationing in wartime is not regimentation

—it is merely applying the Golden Rule clear across the board in a good cause.

BORG-WARNER CORPORATION, *Chicago*

Makers of precision products . . .
on the road, in the sky, on the farm, in the home

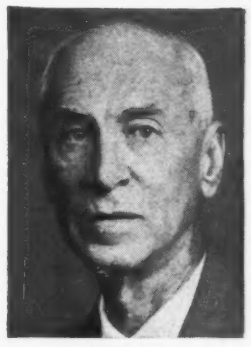
Aviation People

PAUL E. RICHTER, TWA's executive vice-president, has now been called to active Navy duty. A lieutenant commander in the Naval Reserve, he has logged more than 3,500 hr. aloft. Readers will especially remember his forthright maintenance article in December AVIATION.

E. LEE TALMAN, following earlier experience as assistant treasurer of Bendix Aviation Corp. in Illinois, joined TWA in mid-1939 and in fall of same year was named vice-president. TWA now announces his election to fill post of executive v. p. in Mr. Richter's absence.

COL. JOHN S. ALLARD, former Curtiss-Wright vice-president in charge of export sales, also ex-director, Wright Corp., has received coveted Silver Star for striking leadership under fire during occupation of Oran airfield. He serves under another former C-W man—Maj. Gen. Doolittle.

ARCH M. HALL has gone to Pennsylvania to take up duties as acting manager of new Vultee plant making torpedo-bomber aircraft. He has been division manager of Consolidated's Texas company, earlier was president of Hall-Aluminum Aircraft Co., which was bought by Consolidated in 1940.



DR. EDWARD C. SCHNEIDER, biologist of Wesleyan U., Middletown, Conn., is winner of John Jeffries Award for '42. Honor by Institute of Aeronautical Sciences tokens his aeromedical pioneering. Specially lauded: His development of physical fitness test for pilots.

G. J. NEWMAN, v.-p. in charge, Consolidated Texas division, named among outstanding young men for '42 by U. S. Jr. C. of C. Now 34, he's blazed firm's way since its founding in '23. Prime production man, he's test piloted, too, holds 9 hr. 57 min. trans-continent mark flying B-24.

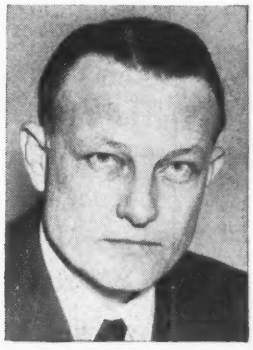
JOHN E. PARKER, who has assumed presidency of Northwestern Aeronautical Corp., Minnesota firm engaged in building of transport gliders for AAF. One of company's organizers, he formerly served as chairman of its board. In addition, he has been member of Northwest Airlines board.

C. A. HERBERTS, founder (June 1940) and president of Aerco Corp., Los Angeles assemblies and parts firm, is aviation field "oldtimer." Once a tool and die maker, he still keeps his hand in. A subsidiary of Transamerica Corp., his Aerco is believed youngest plant in West to win "E."

EDWARD C. WELLS, Boeing's assistant chief engineer, has been selected by Institute of Aeronautical Sciences to receive Sperry Award for '42. Credited with "proto" design of "Fortress" and many later improvements, his associates term him leading advancer of big bombers.

LOUIS KAHN, now president of Albert Kahn Associated Architects & Engineers, company which constructed leading aviation war plants. Long the organization's secretary-treasurer and executive head, his election followed recent death of ALBERT KAHN, noted firm chief.

MAC SHORT, vice-president in charge of engineering, Vega Aircraft Corp., is now president of the Society of Automotive Engineers, his election coming at recent annual meeting of SAE in Detroit. He was formerly the Society's vice-president representing aircraft engine interests.



Harris & Ewing photo

JOSH (JOSHUA BRYAN) LEE, ex-senator from Oklahoma nominated by President to serve remaining year of unexpired term of George Baker as vice-chairman of CAB. Known to be aggressive, Lee has participated in aviation committee work.

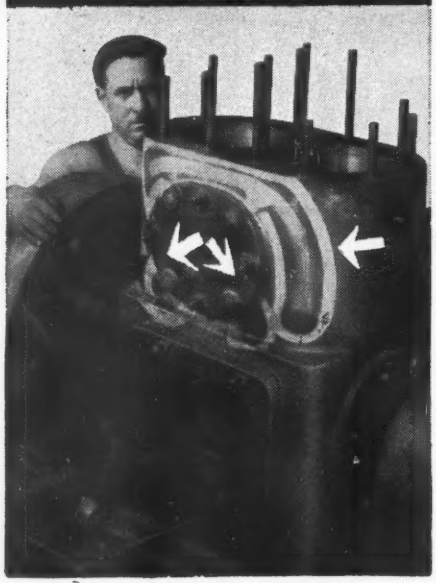
SAMUEL S. TYNDALL is new manager of public relations for Curtiss-Wright's Propeller Division in New Jersey. Transferring last June from Indianapolis to become eastern plant's coordinator of employee activities, he was aviation editor of Indianapolis Times prior to joining C-W.

MAJ. GEN. CARL A. SPAATZ now heads new Allied Air Force in North Africa. Included in this unified U. S., British, and French aviation command are 12th AAF under Maj. Gen. Doolittle and Eastern Air Command under Air Marshal Sir William Welsh. Added are French units.

PETER N. JANSEN, former director of manufacturing of Curtiss-Wright Corp. in New York State, has become general manager of the Airplane Division, thus is now in charge of all integral manufacturing plants. He joined Curtiss in '16, helped build celebrated NC-4.

Castolin Eutectic

LOW TEMPERATURE WELDING



Large two cylinder air compressor with badly cracked water jacket. Salvaged with Castolin Eutectic Low Temperature Welding Alloy. No general preheating. Time: 1½ hours.

IMPROVED RECLAMATION OF CAST-IRON CASTINGS

WHY waste time and materials? Reclaim broken, cracked, worn or defective castings, easily, economically. Use Castolin Eutectic Alloy #14 (gas welding) and Castolin Eutectic Alloy #24B (AC-DC metallic arc). These new low temperature welding alloys assure you of a completely machinable, color matching, stress and distortion free weld every time.

Prominent manufacturers now use Castolin Eutectic Low Temperature Welding Alloys #14 & #24B in place of "hard to get" bronze welding rods. Castolin Eutectic Alloys #14 & #24B contain no scarce metals . . . available with priority A9.

Write for DATA BOOK N8

Castolin Eutectic Low Temperature Welding Alloys are the **original low temperature alloys** that are revolutionizing **production welding, maintenance welding** and **salvaging** in war plants throughout the nation. There are 38 specialized rods for every metal and every welding job. Made only by Eutectic Welding Alloys Company.

Tool Salvaging Poster for your Shop Free!

Some Territories Available for Manufacturer's Representatives

EUTECTIC WELDING ALLOYS CO.

40 Worth St. New York, N. Y.

America At War

(*Continued from page* 110)

ago, that caused the long plateau in the production curve.

All who had correct information knew that the curve would start up as soon as this materials problem was solved. Incidentally, some of the materials that went to speed airplane output were taken away from other equipment which in combat had proved to have less strategic value. Of course many factors other than an even flow of metals are boosting airplane production. One of them is the additional productive capacity effected through construction of new plants plus expansions of existing facilities. This will continue.

But no sooner is one problem solved than a new one pops up. Requirements of war, like the fortunes of war, are unpredictable. To the materials problem, which will persist in 1943, will be added a real showdown on manpower. T. P. Wright, Aircraft Resources Control director, says that in 1941, the aircraft industry's problem was getting tools, in 1942 it was getting materials and in 1943 it will be the combined problem of obtaining materials plus manpower. Airplane producers will have to rake and scrape for metals, for men, and for women this year, but everybody knows they will get them, because aviation is recognized as a most vital weapon, even ahead of tanks.

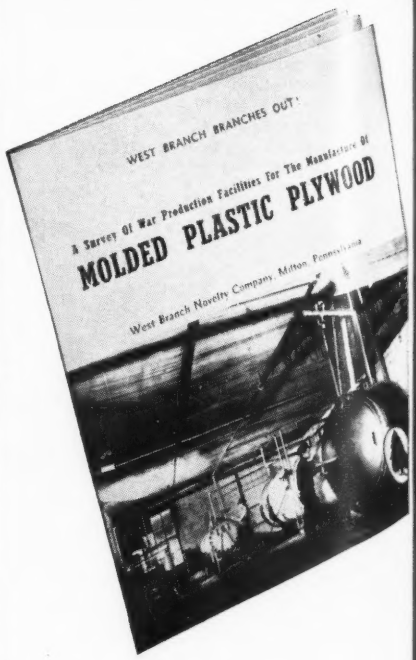
Yes, the problems will be solved. Army, Navy, and WPB made a joint New Year statement in which they estimate that about twice the number and about four times the total weight of planes built in 1942 will be built in 1943, with emphasis continued on bombers designed to carry the maximum of destruction to enemy fighting forces and enemy industrial centers. Says the statement: "Great importance in the strategic plans for this year is placed on aircraft, merchant shipping, and naval escort and combat vessels." There you have the big three—and note that airplanes come first.

As both Churchill and Roosevelt have said, the enemy's airpower is weakening. Most authorities contend that Japan's and Germany's resources are so depleted now that they cannot materially increase their airplane production. Our present rate, plus that of our allies, is probably enough to beat the enemy. But nobody is betting on that. It is now said in Washington that our 1943 goal is a set number of planes somewhat greater than 100,000. Mr. Wilson predicts that our rate will reach double the present production, giving us 11,000 per month. To build 100,000 planes, it can readily

(*Turn to page* 403)

Learn About a NEW Source!

MOLDED PLASTIC PLYWOOD


WEST BRANCH BRANCHES OUT!
A Survey Of War Production Facilities For The Manufacture Of
MOLDED PLASTIC PLYWOOD
West Branch Novelty Company, Milton, Pennsylvania

This free book — just published—surveys the facilities of the West Branch Novelty Company (a Vidal licensee) for the manufacture of molded plastic plywood. Products, location, transportation, floor space, equipment and type of personnel are all described. *Write for this book today*—you need it to complete your file on molded plastic plywood!

WEST BRANCH NOVELTY CO.

DEPT. A, MILTON, PENNA.

Call it Lightning!

– SAY THE PILOTS

NOBODY had time to name this Lockheed fighter plane when it was born. They just called it by a number, P-38.

Then the pilots sent it climbing over eight miles straight toward the stratosphere, up where even the highest-flying bombers couldn't go. They brought it screaming down out of the clouds like forked vengeance. They jammed down the throttle and it flew faster than any fighter ever flew before. They pressed the trigger-button and saw how *concentrated* fire-power from its cannons and machine guns could rip apart anything on wings—and there was only one name for it: *Lightning.*

So that's its name, a name it earned from British and American pilots alike, a name to watch: Lockheed *Lightning.* Lockheed Aircraft Corporation . . . Vega Aircraft Corporation . . . Burbank, California.

for protection today, and progress tomorrow, look to

Lockheed

FOR LEADERSHIP

Member Aircraft War Production Council, Inc.

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Goodyear tire, wheel and brake tester capable of duplicating action of 80-ton bomber landing at 200 m.p.h.

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figured that we will have to aver-
8,333 per month.

ut, after all, it doesn't matter so
h—as many authorities have al-
dy said—*how many* planes an air
e builds as it does *what kind*. If
were to go to Wright Field and see
e of the airplanes our Air Forces
oratory has in the works, you would
strongly impressed that this is true.
ne mere models of the "shape" of
gs to come, may actually arrive
ker than we expect. . . Some are
planes in the air . . . some are
dy for the front, like the successor
the Boeing *Flying Fortress* recently
tioned by Maj. Gen. Oliver P.
ols, head of the AAF Materiel
mmand. Just as we have more metal
d more capacity to outbuild the Axis,
we have more technological man-
wer to out-design the enemy. We
ahead and we will *stay* ahead in
sign.

Granted the race is far more spec-
ular at the front than it is in the
oratory of the National Advisory
mmittee, the Army, the Navy, the
ny schools and universities working
aerodynamics, and of the manufac-
rers themselves. Judging from late
ss reports, the P-38 *Lightning* is
aling the show as often as any war-
ft. Its ceiling is over 40,000 feet,
ne say its speed is not exceeded in
y air force, and its turning ability
really a revelation to the experts—
que being eliminated by running the
gines in opposite directions. The
nufacturer reports that the P-38 is
ing virtually every job—fighting,
mbing, photography, and what not.

It is known, too, that the Martin
-26 medium bomber has been doing
autiful work, though it hasn't been
ky in hitting the headlines. Now
mes news from Africa that eleven
Marauders, as they are named, were
ecently attacked by five Nazi Me-109's
t 4,000 feet, whereupon two of the
nemy were shot down and one limped
f. There was only minor damage to
ne B-26.

A nice word has just been said by
dm. J. R. McCain, chief of the Navy
Bureau of Aeronautics, for Grumman's
Navy *Wildcat* shipboard fighter and its
Navy *Avenger* torpedo plane. "There
re no finer all-around aircraft of their
lass in service today," he says. Even
etter, he credits them with saving
Australia from Jap invasion.

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nywhere, is Britain's new *Spitfire* with
he Rolls *Merlin* 61 engine, said to
ive high performance at nearly 40,-
00. These new editions of the war-
raft that stopped the Nazi 1940 blitz
re beginning to appear in numbers.

Moving to the Orient, we find two
new Jap fighting planes have come up.

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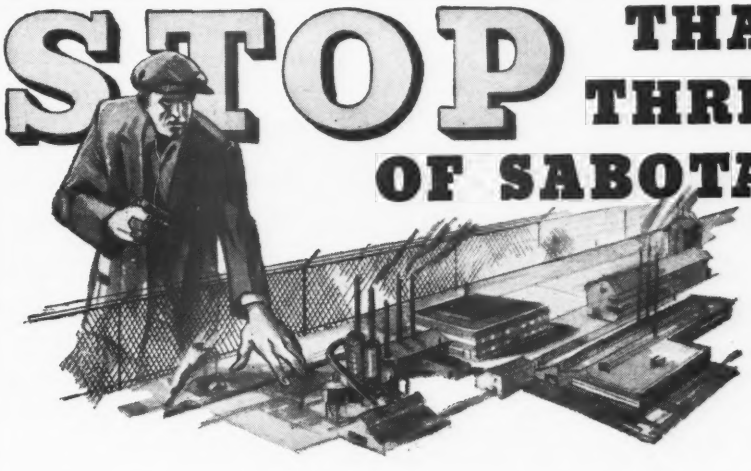

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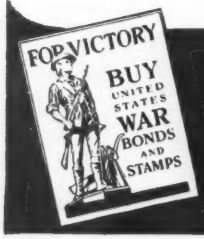

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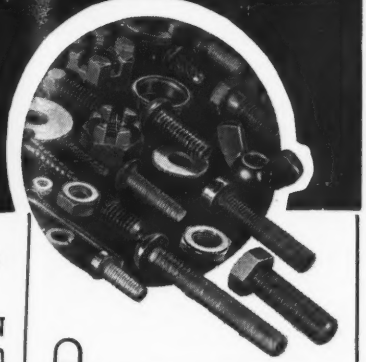

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One is the 97-2, similar in appearance to the Messerschmitt 109 except that it is aircooled. Observation indicates that it has a speed of about 330 mph., 20 mi. faster than the over-famous *Zero*. At some favorable levels, the 97-2 can muster perhaps 50 mph. in addition to its indicated 330.

The other plane is the I-45, a twin-motored craft that was used for reconnaissance last June but which now appears as a fighter. It is like the Me-110 except the engines are aircooled. Neither plane is strictly new other than in the sense of replacing older planes.

Incidentally, officers from the Eastern front have been sizing up the *Zero* as a Nipponese mistake. The Japs designed it, thinking this war would stress dog-fights like World War I. Thus they emphasized rapid climb for getting on top and the quick turn for getting away or cutting in. They now realize their mistake too late. There is no Jap plane in the air that constitutes any serious threat to British and American equipment.

Getting back to our own Air Force, our P-40's, P-39's, and P-51's continue to "do their stuff" as in times past. The two heavy bombers, B-17 and B-24, are maintaining their devastating reputations, although the enemy, as one might expect, has now found ways of hurting them more than they did at first. Communiques have said little or nothing, so far, about the two new 2,000-hp. fighters: Navy's Vought-Sikorsky F 4-U and Army's Republic P-47. You will have to wait for responsible officials to release news and comments on these two planes.

American Air Power

(*Continued from page* 115)

for front rank position, giving Great Britain, France, and Italy cause for considerable worry. Japan was augmenting her aircraft strength with almost frantic haste.

Meanwhile, the United States ranked first in commercial aviation, first in military aircraft performance, and first in naval aviation, but as indicated above it was fifth in number of combat planes. Our program had not been set, except for the objective of the Baker board (1934-35) i.e., to attain by June, 1940, a balanced Army Air Corps of 2,320 modern, serviceable airplanes, a proper complement of personnel, and to provide an adequate number of properly equipped bases from which to operate.

American Air Theories

However, if we were short on officer pilots, men, and planes, there was no dearth of ideas. Air power was something big, with almost endless possibili-

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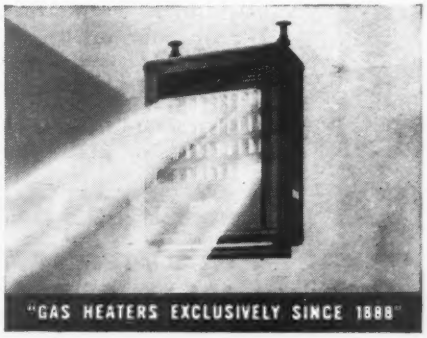

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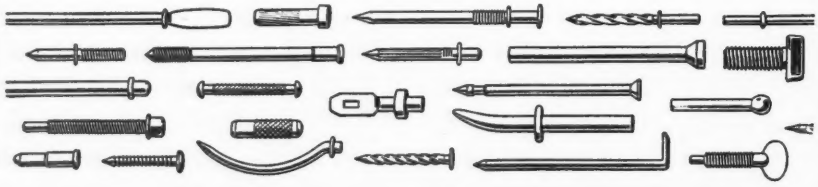

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ties. Most of the men had been close associated with Gen. Billy Mitchell a had absorbed some of the sounder pri ciples of Italy's Gen. Douhet. The doctrine these leaders hammered o crystallizing earlier theories and ide was based on the needs and proble of America. Giving attention to o ocean barriers and huge inland are separated from potential enemies thousands of miles, and with tradition offensive rather than defensive fighti spirit, they developed the *long ran bomber as the keystone of air pow* The American problem (as contrast with that, say, of Britain or German was long range offshore operations u der favorable weather conditions—whi demanded sufficient *altitude* to fly abo ships' anti-aircraft fire, and on t other hand required extreme *bombi precision,* since a ship is a small targ from 20,000 ft. and *up.* As a part this emphasis, the precision bombsig was developed for *daylight* operation and the large bombers were to be ha dled by highly trained *combat cre* which included specialized bombardie and aerial navigators. Long range o erations over land objectives were su ject to the same general consideration

The second problem was the develo ment of *attack aviation,* cooperati work with ground forces consisting suitable airplanes and technique f fast, low-flying sweeps against specifi targets, with heavy machine gun, ca non fire, and light bombs.

A third subject for study and e perimentation was *fighter* operation with special emphasis on interceptio of enemy planes and air defense.

In addition to the above there aro a demand that air power be self-sustai ing by means of a fully developed *a transport service,* with the slogan, "A air force supplies by air."

These dynamic ideas have reached high measure of fruition (1) in the ou standing success, in many widely sepa rated areas, of the Boeing B-17 *Fortre* and Consolidated B-24 *Liberator* hig altitude heavy bombers, and the Sperr and Norden bombsight and intricat navigational instruments; (2) the ligh or attack bomber, of which the speed hard-hitting, versatile Douglas A-2 *Havoc* is the current example; (3) th specialized types of fighter planes fo Army cooperation and for interceptio of enemy planes; and (4) the amazingl expanded world-wide service of the A Transport Command.

Certain other general principles gov erning the creation and operation of a air force were developed by thes leaders, and they have been completel vindicated by recent events. These in clude the beliefs:

—that an air force may be i

(*Turn to page* 409)

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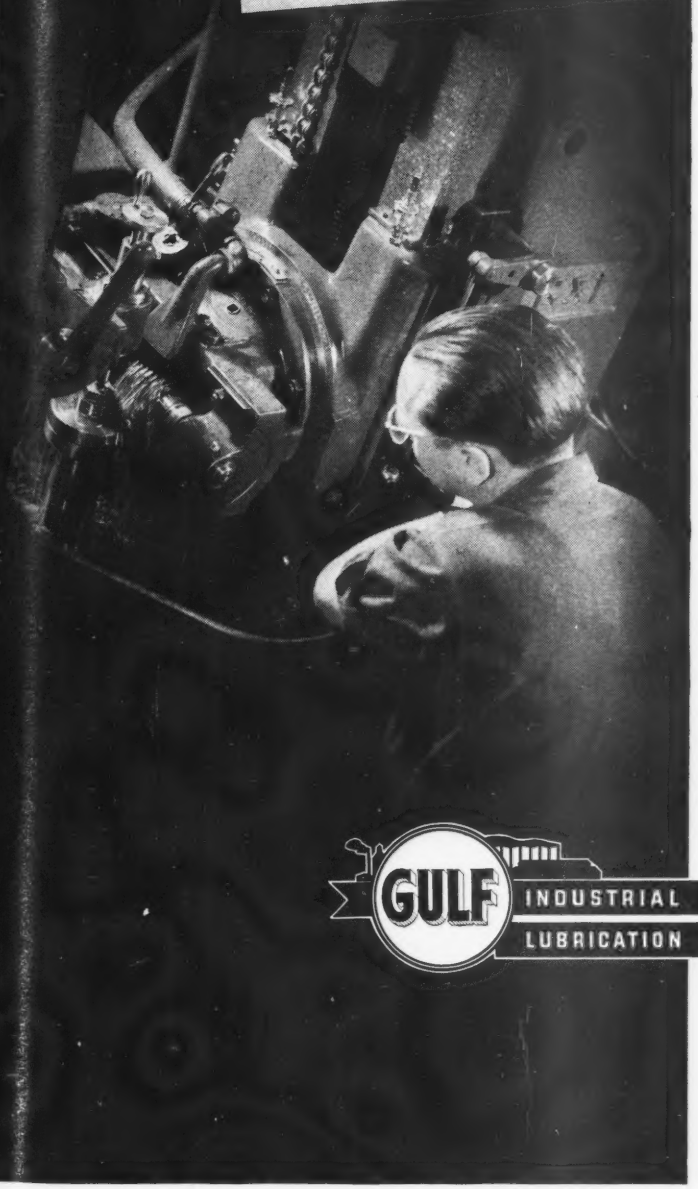

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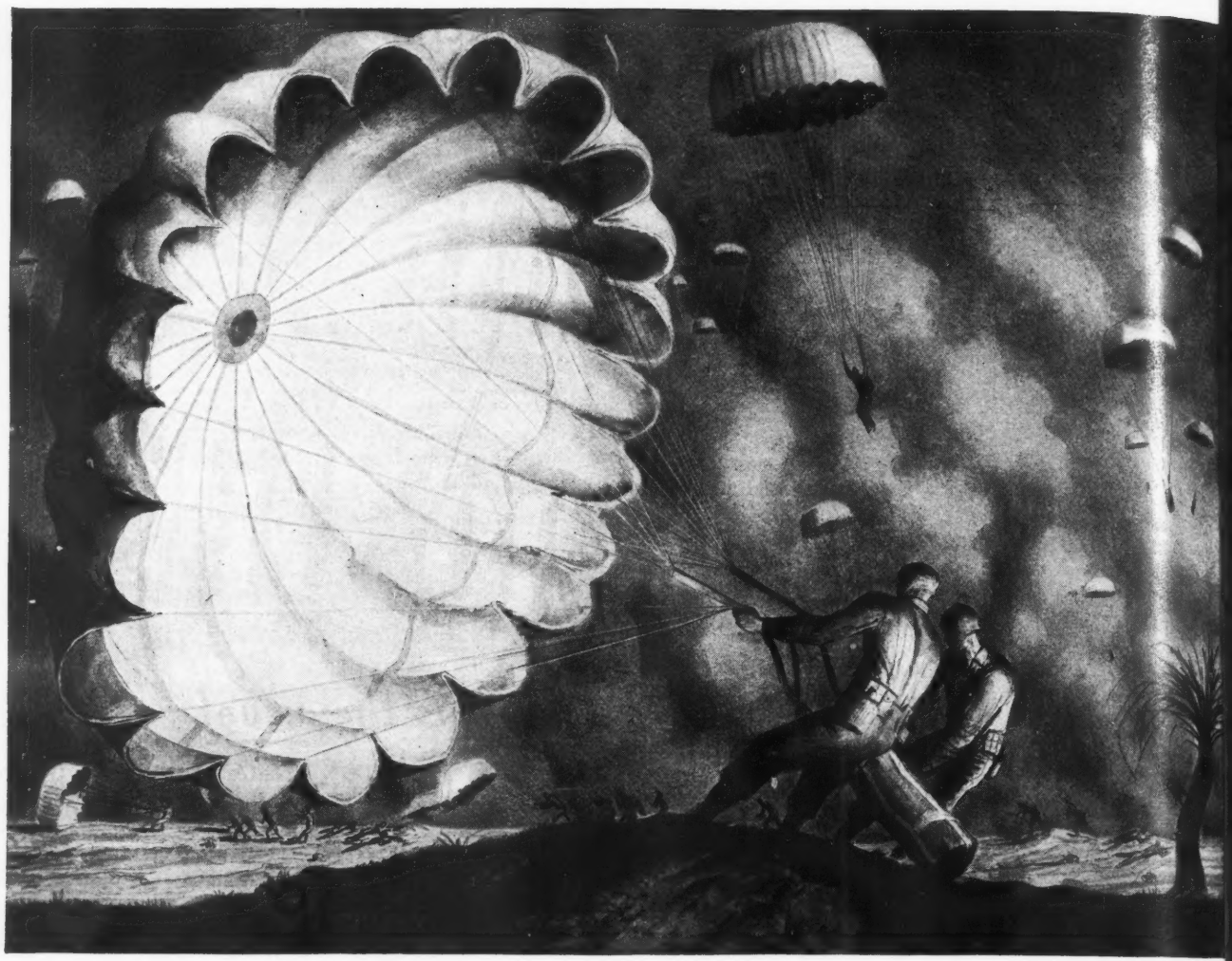

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ng when war is declared, or at least e a framework of organization, for ining and for procurement of air- rt, which immediately can be ex- nded on a large scale.

—that air forces must be balanced mpounds of at least three essential redients—airmen, air bases and air- nes, and that for far flung opera- ns a fourth is essential—air supply.

—that Air forces are not merely iliary components of armies and ies, but that in addition to the ad- ted importance of close cooperation h ground and sea units, they may e separate and distinct missions— t they may materially affect the lity of the enemy to wage war by troying his manufacturing establish- nts, power, and communications.

—that airplanes are the weapons longest range and greatest mobility. ns, among the important projects rked out by the GHQ AF are in- ded the 20-ton B-17, the 35-ton B-15, d the 80-ton B-19. Our present heavy mbers, and the super-bombers just r the horizon, owe a tremendous debt these revolutionary giants.

—that military airplanes must be varying and proper types, designed carry out specific missions. There st be long range bombers capable of ching any part of the enemy domain, t also medium bombers for destruc- n of objectives at shorter range, and ht bombers to work in close coopera- n with the ground forces. There must fighter aircraft to intercept enemy mbers, destroy enemy fighters in air mbat, and gain local air supremacy r ground operations. There must also reconnaissance aircraft for the gain- g of military intelligence by observa- n and by photographs, transport and rgo planes, and various types of iners. These separate and distinct pes must be provided in proper pro- rtion to make a balanced air force.

—that the production rate of nes turned out at the factories was t the final criterion as to whether our forces were being properly supplied h military aircraft. The only planes ich counted, as a practical matter, e those which are completely ipped, with all instruments, ammuni- n, etc., and available for action.

—that for proper defense of this ntry, advance air bases must be lt up in such strategic areas as the ribbean, the Canal Zone, and the waiian Islands, and that Alaska is primary importance in the control the Pacific. This last point was given matic emphasis in the flight of Mar- B-10 bombers to Alaska in 1934 der the leadership of Brig. Gen. Hap" Arnold.

It was this demonstration of effi- ency and practicability of the low-

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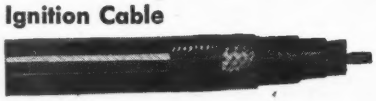

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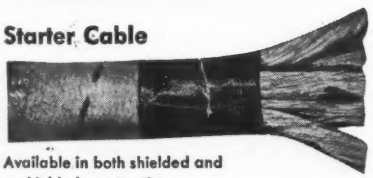

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wing all-metal multi-engine bomber for long distance operations which led to the development of the B-17, our primary offensive weapon in 1942-43.

Bomber Pioneers

We have noted some of the air officers instrumental in the development of the long range bomber, Gens. Arnold, Andrews, Emmons, and Col. Knerr. Who are some of the others and where are they now? Notable are:

Maj. Gen. Lewis H. Brereton, commander of the Ninth Air Force, Middle East, under the over-all command of Lieut. Gen. Frank M. Andrews, who was transferred to this command at the time of the North African coup; Maj. Gen. Ira C. Eaker, chief of the Bomber command, European theater; Lieut. Gen. George C. Kenney, air chief under Gen. MacArthur (Gen. Kenney was in charge of G-3, Operations, on the GHQ AF staff, and is regarded as one of our outstanding air strategists); Maj. Gen. Follett Bradley, now in Russia, who headed G-2, Intelligence; Maj. Gen. Joseph McNarney, General Marshall's Deputy Chief of Staff, who was in charge of G-4, Supplies and Property; Maj. Gen. Robert Olds who had charge of the development of combat crews to operate the B-17's as fast as they became available in 1937-38 (it is more than interesting to note that as commanding general of the Second Air Force (Northwest) he is at present continuing this vital task, officially termed "operational training"); Maj. Gen. Willis Hale, chief of the Seventh Air Force, Hawaiian Department, under Lieut. Gen. Emmons; Brig. Gen. Caleb V. Haynes, chief of the India Air Task Force, Tenth Air Force; and Maj. Gen. Harold L. George ("Bombardment George"), commanding general, Air Transport Command.

In most of the spectacular flights of the *Flying Fortresses,* such as the goodwill trips to South America, non-stop flights to inspect progress of the air defense bases in Puerto Rico, Canal Zone, etc., the big ships were usually piloted by Haynes, Olds, or George (then majors or colonels). The group of about a dozen long range bombardment specialists, plus a couple of fighter experts we shall name later, are the ones placed by the Army General Staff in the most strategic spots to blast the way to victory.

Another of these pioneers was Brig. Gen. Walter Eubank, commander of the 19th Bombardment Group, whose amazing record during the first year of our war in the Pacific is almost unbelievable: (He is now director of Bombardment, Air Staff, Washington.)

His group flew B-17's across the Pacific during the autumn of 1941 in

(*Turn to page* 413)

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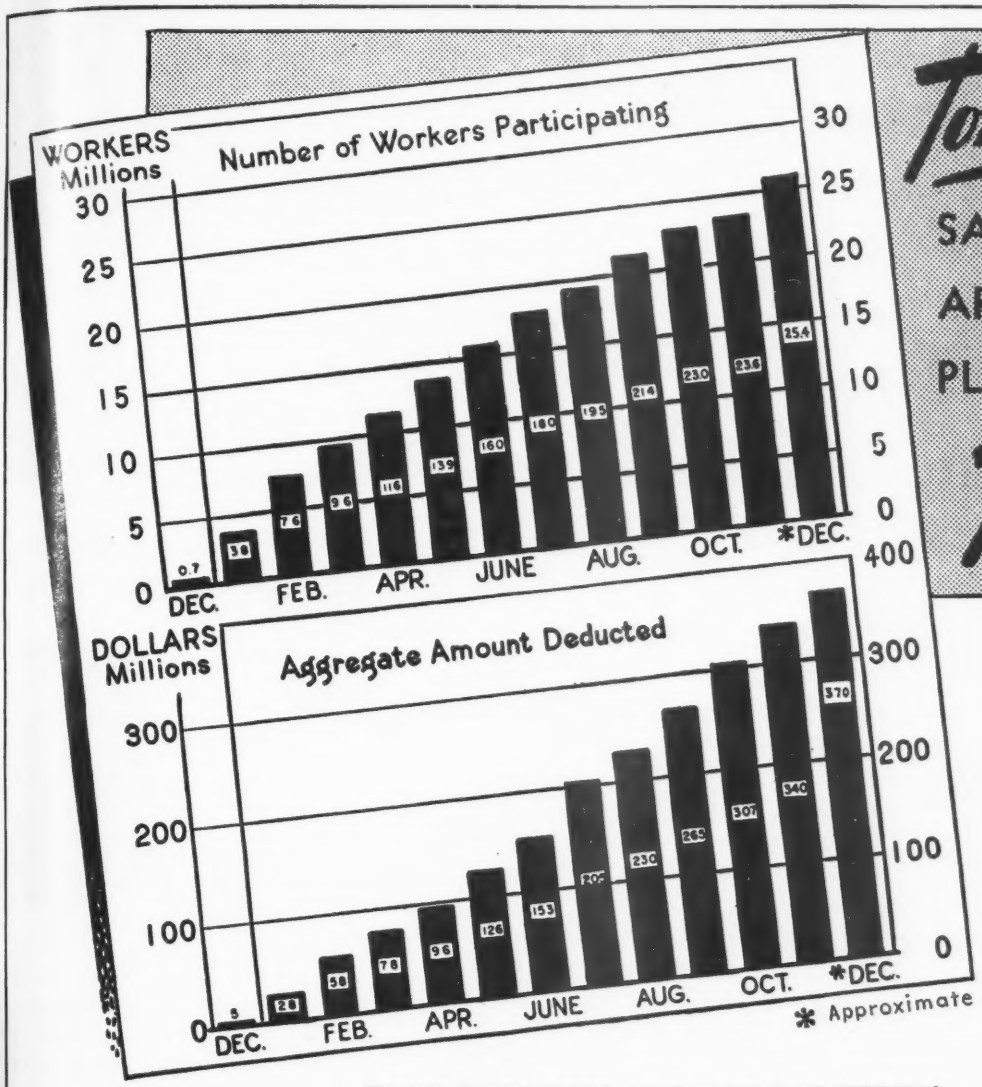

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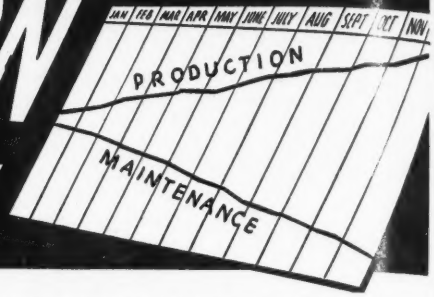

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For Compressed Air Lines

On compressed air lines, Staynew Filters prevent the passage of dust, dirt, rust, pipe scale, and condensed moisture. Solid matter causes clogging and loss of power in air-powered tools; water washes away lubrication or freezes such tools; both solid matter and water may cause delays and waste at other points.

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On liquid lines, Staynew Filters assure clean water, coolants; fuel, lubricating and other industrial oils; many special liquids.

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Many special pipe line filters available, including new "super" filter for the removal of traces of oil and moisture from lines to air-operated control instruments.

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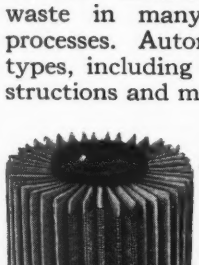
Staynew Intake Filters prevent the suction of dust into engine and compressor cylinders. Dust scores cylinder walls, clogs valves, causes excessive carbon formation, wears reciprocating parts. Users report important reduction in upkeep, continuous efficiency. Complete range of sizes; models include SILENCER - FILTERS.

MODEL D
For Engine Intake

STAYNEW VENTILATION FILTERS *UP* WORKER PRODUCTION, *REDUCE* BUILDING CARE

Staynew Ventilation Filters guarantee delivery of clean, dust-free air, reducing cost of building maintenance, adding to efficiency of employees, eliminating health and accident hazards and preventing waste in many operations and processes. Automatic and Panel types, including fire-resistant constructions and media.

Automatic Air Filter for Building Ventilation



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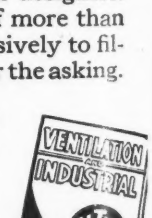

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AIR FILTERS

order to build up our strength in the Philippines. The last of them left March Field on Dec. 6, arrived at Hickam Field on the 7th, then flew on to Clark Field, P. I. Those who remained after the attack there (fifth columnists having destroyed the aircraft warning system) operated for a time from Mindanao, then flew to Java, and later to Australia, one squadron operating as reconnaissance and three as bombardment. Heavy raids were carried out against Rabaul, Lae, Salamau, and other targets in the Solomons and New Guinea, participating in the battles of the Coral Sea, Milne Bay, and the Solomons sea battles.

These air shock troops include many of our Pacific heroes such as Colin Kelly, "Shorty" Wheless (75-mi. battle with 18 *Zeros*), Alvin Mueller (brought back B-17 with 1400 holes), etc. The group has been cited three times by Sec. Stimson, and more than 1,000 medals have been awarded to the dead and living of the 19th.

In their engagements, the lessons hammered out at Langley Field received their baptism of fire and were fully vindicated. As a testimony to the value of close team work in heavy bombing operations, Gen. Eubank states that if a couple of bombers with highly trained crews were sent on a mission, and eight or more with green crews on a similar chore, the results would be about equal. Gen. Eubank, by the way, often accompanied his men on these raids, and on one occasion, after three narrow escapes from Jap *Zero* bullets, he remarked, "I am beginning to believe these so-an-so's of Jap pilots don't *like* me!" Another tenet of American air doctrine—the generals lead their men, rather than send them. Exemplary, too, are Brig. Gen. Ken Walker ("Get the hell back in line") in New Guinea, Brig. Gen. Ira Eaker in the daylight *Fortress* raids over Europe, Maj. Gen. "Looie" Brereton, Maj. Gen. Jimmy Doolittle, etc.

Fortresses in the Pacific

The intrepid 19th Bombardment Group started off with B-17C's and D's, and the speed and ruggedness of these big B's got them through many a tough spot. But when they and others began getting the B-17E's and F's, with two of those wicked 50-calibre high velocity guns in the tail, the fun really began. Another point in American air doctrine was proved to the hilt—the heavy bomber, on account of its long range, must be capable of self-defense, because of the impossibility of fighter planes going all the way with them for protection. The *Fortresses* shot Jap *Zeros* out of the skies by the score.

Before leaving the Pacific theater, it might be well to point out something

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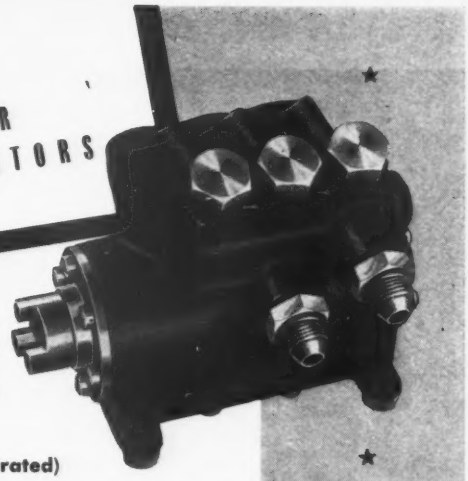

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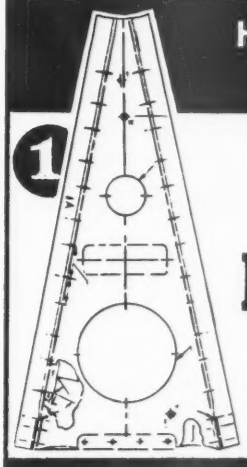

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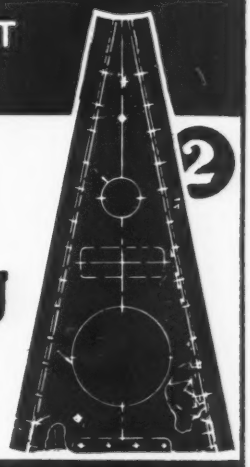

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that is often overlooked in regard to high level bombing at sea. Depending on the size of the bomb, it takes from 30 to 36 sec. for a bomb to drop from 20,000 ft. If a single bomber is overhead, it is entirely possible that a fast ship could maneuver sufficiently in that brief space of time to evade the bomb. However—and this has been particularly true since August, when substantial reinforcements of the latest *Fortress* models have been available in the southwest Pacific—such bombing almost always is done in a close pattern by from 12 to 18 aircraft, and in these circumstances such evasion becomes impossible.

On the other hand, the weather and other considerations frequently make such high altitude work impracticable, and during the past few months, more and more it has been found that both heavy bombers (*Fortresses* and *Liberators*) and medium bombers (B-25 *Mitchells* and B-26 *Marauders*) have been slipping down to 1,500 feet and even lower to get in their deadly work.

This seems as good a spot as anywhere to mention U. S. Naval Aviation, generally conceded to be tops in all the world. Navy planes, including patrol bombers, scouts, torpedo bombers, dive bombers, and fighters, are without rivals anywhere, and Navy training and operating techniques are among the finest.

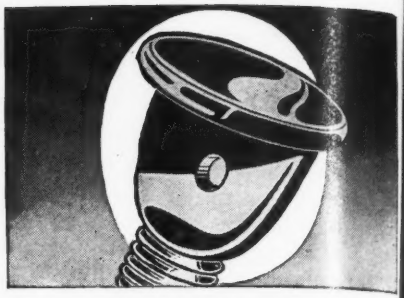
Reversing Opinions

In the European theater, the *Fortresses* had to overcome the handicap of a well-settled conviction held for years in both England and Germany and largely supported by their own experiences in daylight bombing—that no multi-engined plane could hope to stand against the small short-ranged, single-engined fighter, the so called "Queen of the Air." It was feared that our heavy bombers, both *Fortress* and *Liberator* models, would prove no match for the fast, maneuverable Focke-Wulf 190's and Me-109F's and G's, or for the very heavy flak encountered over enemy-occupied Europe.

Two factors were overlooked. First the effectiveness of our 50-calibre guns from all angles, many of them from power-operated turrets, as compared with the lighter 303-calibre guns carried by the British heavies, the *Stirling, Lancaster,* and *Halifax.* Second, the fact that in operating by daylight they could bomb from great heights with a precision bombsight and therefore avoid much of the anti-aircraft fire which night bombers encounter because they come in lower to sight their targets.

The remarkable success of the daylight raids from the start of the campaign in August, with scores of the best Luftwaffe pilots and planes shot

(*Turn to page* 417)



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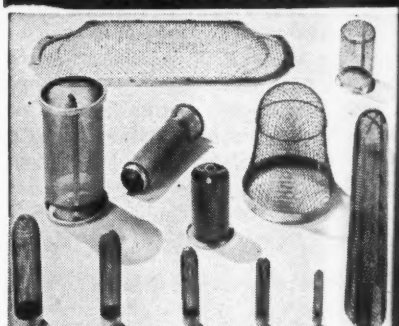

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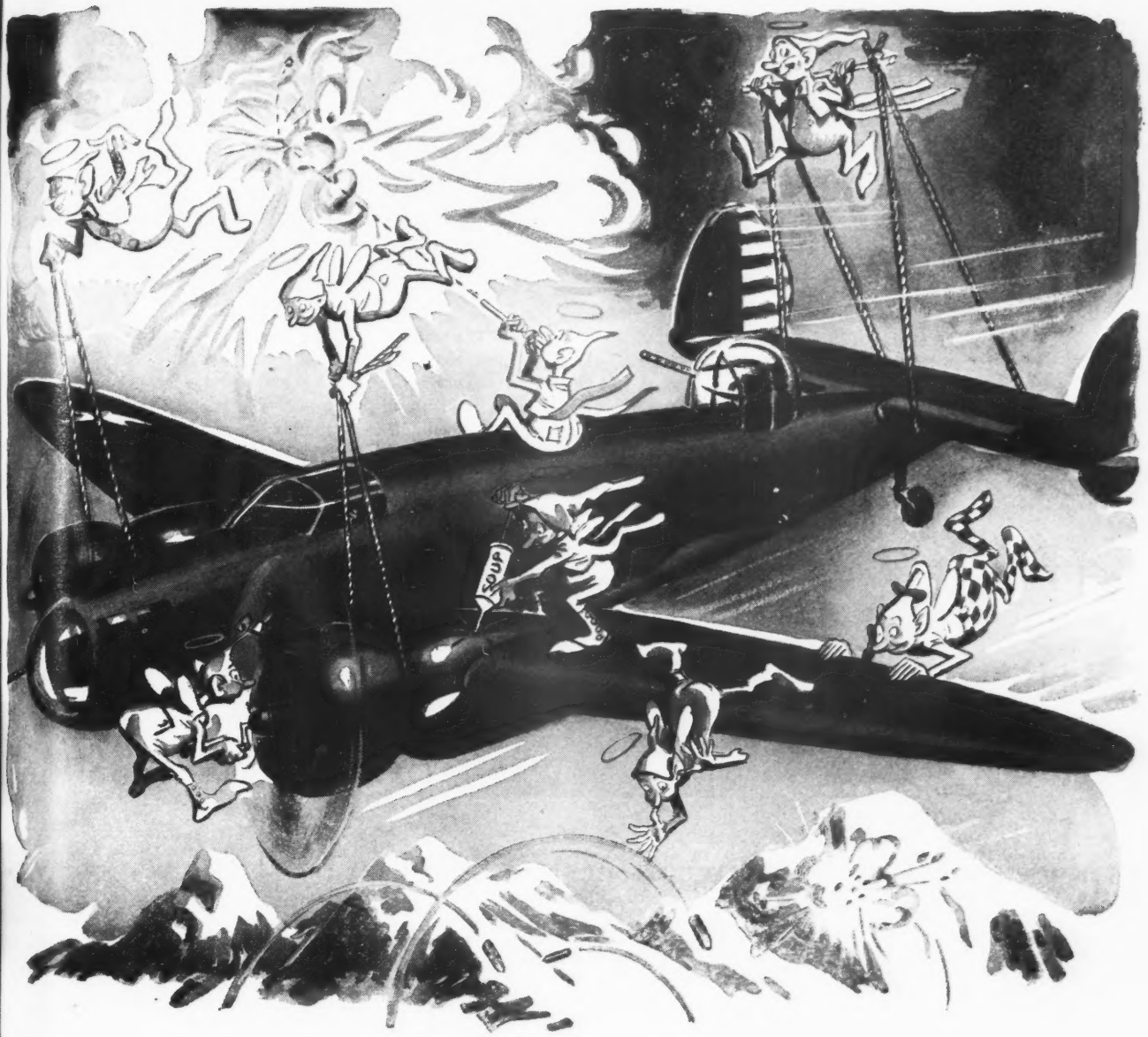

WE ARE THE GOOD LITTLE GREMLINS

THE bad gremlins have gotten themselves talked about so much you hardly hear about us good gremlins. Let us tell you:

We're the gremlins that stretch the last few gallons in your reserve tank so you can just make the landing field.

We're the gremlins that give your engine a little extra bit of soup to pull you out of a Jerry's line of fire.

We're the gremlins that get under your wings and lift you over the treetops when you run out of airport.

We're the gremlins that make one engine do the work of two when a bit of ack-ack washes out a motor over Naziland.

We're the gremlins that stave off a stall when your student hangs the plane on its prop.

We're the gremlins that keep you in the air when the bad gremlins put ice on your wings.

We're the gremlins that take you upstairs to get a son of the rising sun before he lays an egg on your flat-top.

We're the gremlins that hoist you over mountain peaks that stray from their moorings and suddenly rise up before you on dark nights.

Yes—we're the *good* little gremlins. And we really exist . . . as the little drops of Ethyl fluid that boost the octane number of every gallon of U.S. tactical, or "fighting grade," aviation fuel.

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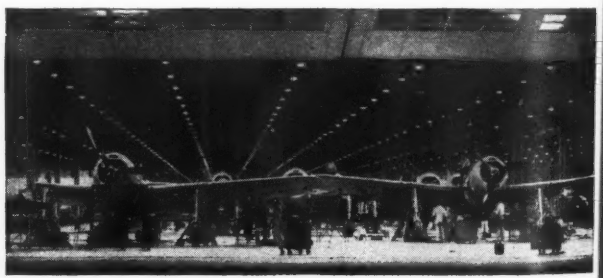
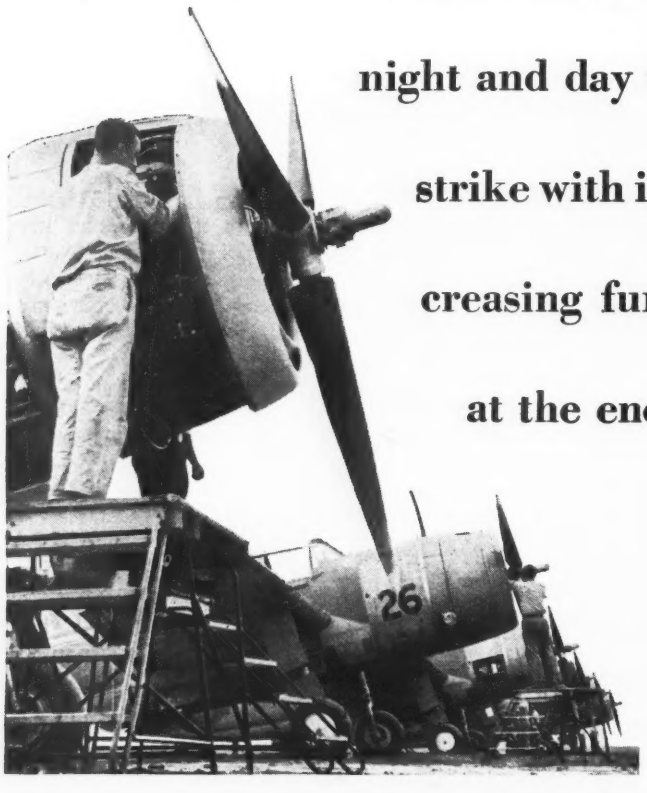


at the enemies of democracy ★ ★ ★ ★



BREWSTER *Blasters*

out of the air at negligible cost to us, and with the smashing of railroad centers, shipping yards, war factories, airdromes, and other military objectives in Axis territory, bears witness to the potency of precision bombing by daylight. It has been reliably reported that the unexpected success of our heavy bombers in precision daylight operations ("where every bomb counted heavily") was the cause of a drastic "re-sorting of basic ideas on air warfare which have stood firm since the infancy of flying." It is noteworthy that frequent and highly successful daylight raids by Britain's ace heavy bomber, the *Lancaster,* have been carried out since early October.

High ranking British air officials have also stated their admiration for the strategic uses to which our air power was being put in the difficult Pacific theater, particularly in such well-planned raids as those by Gen. Royce on the Philippines from Australia, and by Gen. Doolittle on Tokyo.

The arrival of a flock of B-24 *Liberators* in the Middle East, and their effective use in long range operations by Gen. Brereton's Bomber Command during July, constitutes a turning point in the desert warfare, and taken together with another type of aviation about to be described, may be regarded as a major factor in clearing the Afrika Korps out of Egypt. Smashing raids were carried out, resulting in heavy damage to Axis docks and shipping at Tobruk, Bengasi, in Libya, Crete, and Greece. Because of the activity of these long range bombers a corridor by sea and air, hitherto out of range of available RAF medium bombers, was all but closed, and Rommel's supply cut.

If and when all of North Africa becomes a great air base on the south, as Britain is on the west and Russia may on the east, the way will be prepared for devastating blows against the "soft side" of Europe.

Final installment of Maj. Silsbee's article, to appear in next month's AVIATION, *will cover elements of attack bombing, ground cooperation, interception, and transport, as developed by the United States Army.*

Postwar Transport

(*Continued from page* 118)

Yet no other form of transportation ever achieved so much progress in so few years as has aviation. It has explored and conquered a new world, a world much larger than all of the lands and waters it covers. Consequently, I do not believe the answer to the question is to be found without first determining our status in the air. We had to decide how to utilize gunpowder before we gave up bows and arrows. It is not a question of what any single form of transportation is capable of, by itself. It is a question of what effect the most efficient *use of air* can have upon *all* other forms of transportation—of how aviation can change the integrated function and value of all surface methods.

Surface methods are limited to two dimensions. Trains can only go where tracks go on land; automobiles mostly go where there are paved highways; ships travel only where there is water. Because air is everywhere (an elementary fact that we believe requires constant repetition) the air-realm presents the greatest transportation potentials in the history of mankind.

If this premise be sound, then air is now the dominant realm for transportation. Thus we are faced with the need to do first things first: To determine how much we may capitalize the advantages of air. It is up to the American people whether we make air transportation the dominant *form* of transportation.

The correct approach to the postwar transportation problem, we believe, begins with a vigorous, forthright, and intellectually honest revamping of centuries-old habits of thinking.

First, we must understand air—what it is, where it is, what possibilities for benefit it offers if we utilize it, and what dangers its use by others can mean. *Only then can we determine how best to profit from this great utility.*

Proof that this is no easy assignment is found in the record of the slow acceptance of aviation by people everywhere. Today, it is also evident in every war bulletin and in the controversies such as that about battleships versus warplanes. War, not public demand, caused our great production expansion. If we do not seek to understand air, then our minds are out of focus on the postwar transportation problem in its entirety, and we are disqualified as competent planners for the future.

Scientists tell us that every individual has two brains: One, the innate brain,

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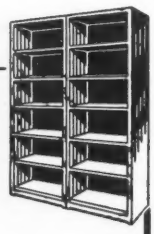
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• Simplifies storekeeping.
• Reduces losses and breakage.
• Saves floor space — allowing *extra* room for *productive* purposes.

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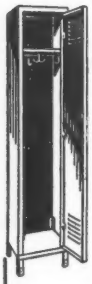
• Help maintain employee morale.
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whose function is to warn and protect the individual structure; the other the intelligent brain, which the individual develops. For hundreds of thousands of years, generation after generation, man has been warned by his innate brain, "don't do it", if it was a hazardous, new, or different thing. Gradually, over the centuries, the resistance of the inborn brain against accepting the ever-changing methods of *surface* travel has been overcome, until the automobile was quickly and universally adopted. But the automobile is a surface vehicle. Never, in all of man's accumulation of habits, has the innate brain been called upon to oppose anything as much as man's getting off the earth's surface and traveling in a heretofore unused realm. Therefore the sum total of the nation's inhibitions concerning air travel is the size of the handicap we will face in postwar transportation competition.

I do not imply that air transportation will remove all need for surface methods. Walking is a method of surface transportation, and it will continue. Oxen made it possible to grade the roadbeds and lay the rails for trains. Horses made possible the building of paved roads for automobiles. But automobiles did not simply do what horses did; they did what horses cannot do. And in so doing, automobiles created wealth that did not exist before. They enabled millions of people to shorten miles and lengthen hours and to enjoy benefits in every phase of their lives.

Could a livery-stable-minded man, thirty years ago, who refused to understand or utilize the automobile, be competent to plan for his community's future growth, prosperity, and welfare? Such a man would have opposed the building of garages and the paving of roads. His spurious reasoning that he was protecting the invested capital in livery stables, carriage stores, and harness shops would, if followed, have doomed his home town to isolation and stagnation in a motorized nation where the lifeblood flows freely between all centers of production, and markets.

Is the foregoing a ridiculous hypothesis to adopt when considering our postwar transportation problems? We think not, because we believe the increasing use of air will bring a transformation all over the earth, even greater than that which automobiles accomplished within continental United States. The use of air will do it in less time, with effects that will dwarf the changes brought by motor cars. We base that belief (and again we

(*Turn to page* 421)

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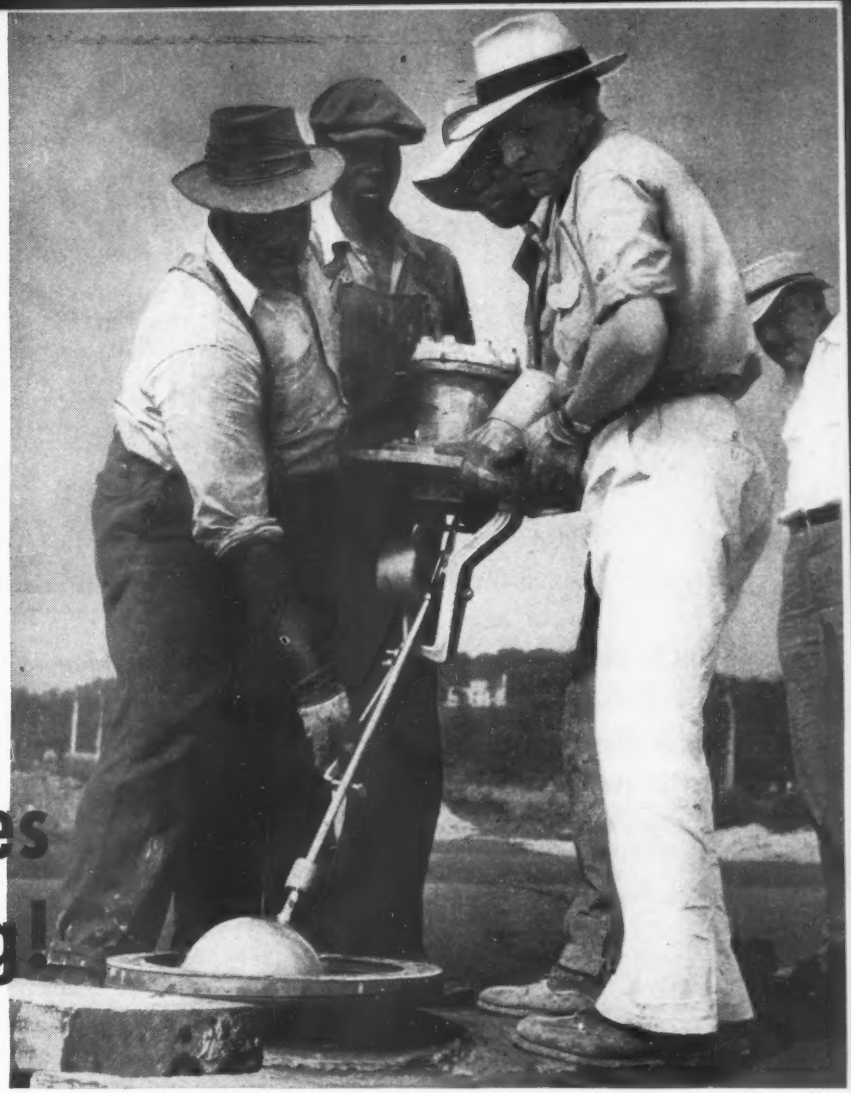
Installing one of the main units in the storage tank of an Aqua System



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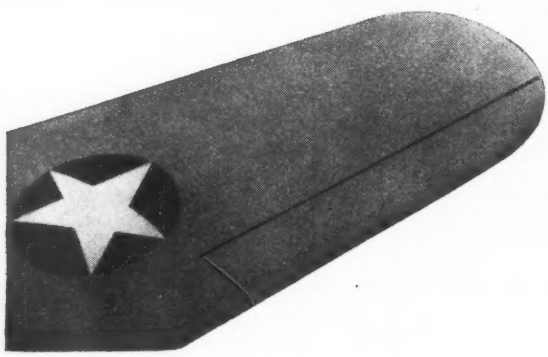
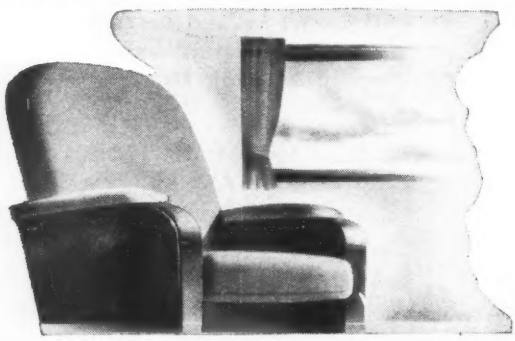
SINCE the '90s, the highest tribute to the reputation of Zapon Division and Zapon-Keratol Division has been the continued friendship of the thousands of customers whose good will we have earned through the years. Unremitting Zapon research, cooperation and understanding of customers' problems have characterized our relations. For the future, Zapon combines with all Atlas in development of finishes and coated fabrics for the aviation industry.

ZAPON INDUSTRIAL FINISHES cover a wide range of uses and fully meet both Government and industrial specifications. Lacquers, enamels, synthetic enamels, novelty finishes — Zapon has developed coatings for every industrial requirement. The most exacting finishing problems have been a challenge. Today, we are busy with finishes for military aviation and other war needs. Yet even now we see in many new Zapon developments promising materials for post war uses.



ZAPON-KERATOL COATED FABRICS have long enjoyed a reputation of the highest quality for seating and wall covering. Sturdy, long wearing, resistant to flexing and ageing, they combine function with beauty. Their color, finishes, designs and grains have appealed to a long list of designers, decorators and upholsterers. Though these facilities are now turned to the production of needed war materials, our skill and our new developments in manufacturing coated fabrics promise remarkable new materials after the war. New resins for example may revolutionize present manufacturing practice.



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reiterate) upon the fact that air is everywhere. It is the same everywhere, and wherever there is air, airplanes can travel. That means the proximity of places and peoples assumes a new meaning—be those places in our own states or in near or distant foreign lands.

Like it or not, air *does* physically unite all human beings on earth into a group of close neighbors.

It is not a question of what aircraft are capable of doing, either those we now have in the air or on the drawing boards. We see no limit. We believe that, sooner or later, far more things that are now being transported by surface means, will also be transported by air . . . quicker . . . and cheaper. A short time back we heard very little about cargo planes, but today they are accepted and are an important factor in air transportation planning.

The only question, in our opinion, is what Americans want aviation to do for them. The real ponderable in this problem is in the minds of men, not in our engineering genius, not in our aerodynamic experience, not in our production or operation capacity.

I make no specific predictions for the expansion of airlines in the postwar period. I do not claim that we will be transporting coal and iron and wheat by air ships, but I am satisfied that in the very near future—by the advent of peace, at the latest—air transportation will be hard pressed to meet the demands put upon it for vastly increased transportation of passengers, mail, express, and cargo. With hundreds of thousands of our expert flyers relieved from war, with millions of other skilled personnel available, with tens of millions of our people definitely airminded, to say nothing of the manufacturing and engineering capacity clamoring for a chance to meet the new challenge of the air, one would indeed be stupid to underestimate the future battle for business which I believe will be waged in the air. International competition in the trade routes of the air will surely eclipse all previous international ocean-going competition.

Recently, a business man who regularly travels by air said, "Consider this pencil in my hand as a postwar transport plane. We assume that it is larger and faster than any in service for domestic airlines at present. Now, what troubles me is this: When I think of how *much* such a *single plane* of its enormous pay load capacity and high speed is capable of transporting, I wonder whether we shall need all of the capacity of our war-expanded airplane factories after the war."

The reply he received cited a hypothetical livery-stable man who could have said years ago: "In my hand I hold a lead pencil. Let us imagine that it is a horseless carriage. When I consider how much one automobile is capable of doing, will we need a large automotive industry?"

The moral, obviously, is that the automobile did not primarily replace the horse. It made possible new transportation radii and new transportation efficiency. It increased transportation infinitely beyond the utmost of horse-drawn vehicles. So it is with the airplane. It does not "replace" surface methods, it supersedes them. It makes possible what is impossible for surface types. Therefore, much of the contemporary controversies about airplanes are founded on a false premise of comparisons.

If you are asked, "What do you think the future is for railroads on land, or for ships on oceans?" counter with this question: "What do you think is the future of aviation in the ocean-of-air?" In ratio, as you envision, and want, aviation, you will have it. Once we do have it, in the fullest measure that constitutes good business, *then all surface methods will automatically fit into their relative and valuable places, "functioning as an integral part of the*

(*Turn to page* 422)

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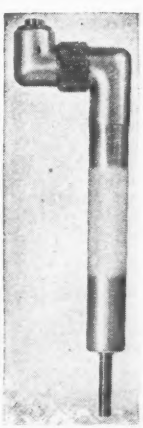

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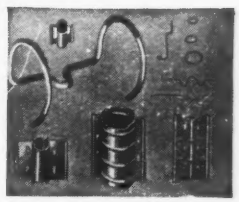

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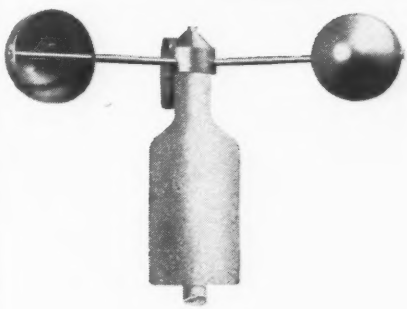

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whole system" of American postwar transportation.

Let us not "set the cart before the horse". It is unproductive to try to measure the potentials of universal air by the limitations of surface-bound foot-rules. Especially let us immediately face the need for the United States already to be dominant in the air when our Allies shall sit around the peace table with us. It is obvious that nothing is more necessary to our postwar transportation than the strengthening and developing of our facilities in the air both now and in the future. I firmly believe that the major victor in the peace will be he who goes into those conferences with the strongest position in air transportation.

Financial Outlook

(*Continued from page* 116)

The provision was to apply to all new contracts and to all open contracts upon which final payment had not been made, and there were other clauses to put teeth into the provisions, such as measures to withhold payments if profits were excessive, to bring action in appropriate courts, and to impose fines and prison sentences for wilfully failing to furnish data or for supplying false and misleading information.

At the outset, this section was alarming to the aircraft manufacturers. It was feared that this measure would consume time and energies that should more appropriately be directed towards the production lines. But some of those in the industry considered Public Law 528 a provident measure, since it was a means of avoiding the potential stigma of profiteering.

As AVIATION has repeatedly indicated throughout the past year, many aircraft contractors cut prices voluntarily once they found their estimates of costs had been too high and an actual base was established for existing price schedules. For an industry that barely existed then was suddenly called upon to accomplish a "miracle of production," there were no previous guides as to what unit costs would amount to under volume output conditions. Once these new cost standards were established, rebates were made voluntarily, before the passing of the law.

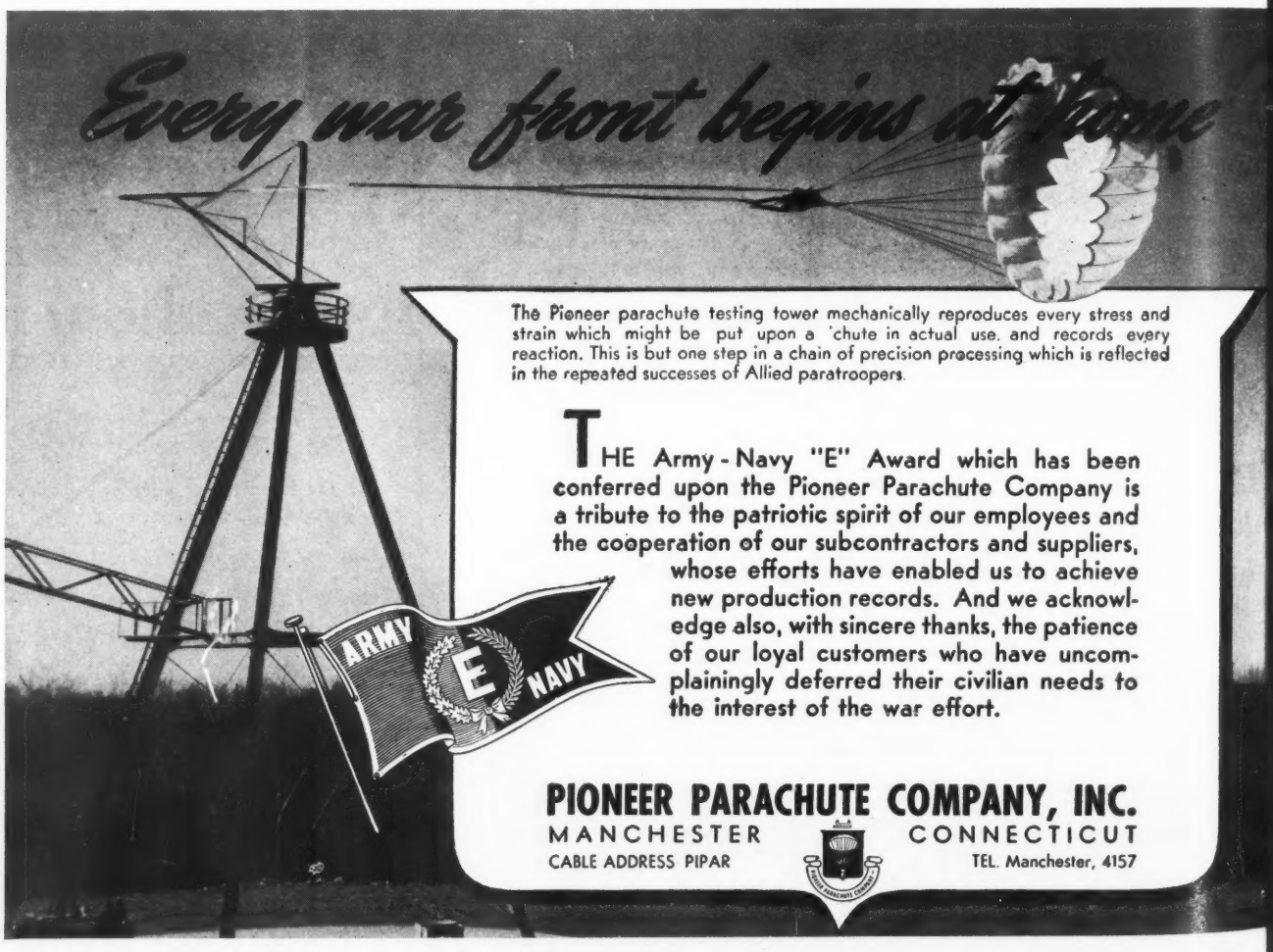
The military services have also been pleased with the workings of the renegotiation processes. While it is difficult to segregate savings on aircraft contracts, an overall estimate is available for the entire war production program and it gives an indication of the rebates returned by the aircraft builders.

Maurice Karker, chairman of the W Department's Price Adjustment Boar has announced that as of Jan. 1, 19 the savings through renegotiation contracts amounted to $1,000,000,0 The Navy Department's Price Adju ment Board estimates that on Oct. it had obtained or was negotiating funds and price reductions of $46 000,000 before taxes, while additio price reductions of about $100,000,0 had been made voluntarily in anticip tion of renegotiations.

Adding these savings, with estima for other voluntary and renegotiat refunds of the other procurement age cies and the Army, it appears safe say that up to the present time t cost of the war has been reduced at least $2,500,000,000 before and sin Public Law 528 was enacted.

Mr. Karker recalls that "few piec of legislation have aroused such a fur in business circles. The law w attacked as an invasion of fundame tal rights. It was described as t legalizing of "welshing" and a hig handed repudiation of obligations e tered into in good faith."

Happily, this did not work out this expected manner. Instead of r capturing past profits as a steady di the renegotiation process is becomi concerned with forward pricing.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